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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE

INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

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Forthcoming Events.

Institution of British Foundrymen.

Glasgow Section.—"Cast Iron and its Constituents," by — Turner, on March 26.

Falkirk Section.—"The Smelting of Pig-iron," by Alex. Anderson, on March 18.

Birmingham Branch.—"Improvements in the Annealing of Malleable Castings," by E. Miller, on March 11.

West of Scotland Iron and Steel Institute.—"The Work of Sorby and the Development of Metallography," by Professor C. H. Desch, on March 17.
—Annual general meeting, on April 27.

Foundry Apprenticeship.

We are brought back to this subject by a letter we received from the North of England, the object of which was to show that there were many small items, always allied to wages, which operated against the enthusiasm of the boy for foundry work. A typical case was where an apprentice on piece-work lost a little money through attending lectures during working hours and receiving only day-work rate. Surely, even in these hard times, it is a little sordid to allow such a paltry matter to stand in the way of getting knowledge which should enhance his usefulness in his trade. We cannot imagine that even an aggregate of such small matters would keep boys from entering the foundry, but rather that a prejudice has arisen due to a poor status as resulting from poor shops. Monsieur P. Vernier, writing in "Arts et Metiers," gives a description of a foundry, and though he speaks of French industry, the conditions sometimes appertain in this country, and are largely responsible for keeping youths out of the foundry. Literally translated, Mr. Vernier states:—

"The foundry is dirty; in some cases it is made up of a venerable construction which bends under the weight of years. It is a place where one cannot see clearly, where dust has accumulated everywhere, and where the spider rules as mistress and takes pleasure in obstructing the all-too-rare passages for light which the designer has too parsimoniously distributed. In general no order is exhibited as to the arranging of the boxes, the heaps of sand and patterns. The few clear gangways which are provided to the different shops are littered up with nondescript material of no immediate utility. The moulder himself is often dirty, and sometimes a heavy drinker, as the foundry dust requires a good deal of slacking. Foundries get warm during casting, and splashes of iron and sparks abound everywhere."

Whilst this description is exaggerated, it is here where the difficulties of obtaining apprentices exist.

Obviously, if it is difficult to attract an ordinary craftsman to the foundry it is still harder to attract the type of man destined to become a manager. Again, on this subject, Mr. Vernier has some interesting views which we also translate literally:—

"It is not astonishing that under these conditions the foundry manager stays away from this repulsive place and only enters like a gust of wind where his presence has become indispensable: but he cuts the visit as short as possible, because he exposes his clothes by express route to the liability of being transformed into something approaching a dish-cloth, and his immaculate collar becomes a beautiful black. However, this important person is quite wrong—he does not understand his position. Alas, it must be confessed, foundries are occasionally managed by men who have never or rarely lived the life of a foundryman. He has contented himself to read the books of experts, who are but imperfectly informed on the real practical side of foundry matters. He is perplexed by many obscure and vague points, but the labourer knows how to mix the sand, and the furnaceman will, at any time, enlighten him and additionally there is the foreman who has grown white in harness and whose value and infallibility have been made sacred by forty years of service.

"Too often, the foundry manager who is inadequately trained for his job does not show sufficient energy to find out for himself not only the reason, but the reasons which actuate such and such a fact or phenomenon more or less disturbing."

All these remarks boil down to the fact that the French and British foundries do not universally attract the best personnel because they are old fashioned in far too many senses.

Ealing Park Foundry.

There does not appear to be any valid reason why London foundries should not produce the whole of the iron castings required for local consumption. We need not in this article enter into the why and wherefore, but it is an indisputable fact that at the present time the bulk of the castings used in the London district are made in the Midlands, the consumer's explanation being that he gets better castings, and it is reasonable to assume the position is summed up in that explanation. That being so, there is certainly room for a foundry in the London district capable of producing castings of a quality suitable for the London market.

It was in the light of the possibilities referred to above that Mr. H. Shannon established himself in Junction Road, South Ealing, in November, 1918, and Mr. Robert J. Shaw, the present technical director, was selected to design and lay out a foundry for the production of high quality light and medium castings in iron and non-ferrous metals. In April, 1920, for the purposes of expansion generally and the manufacture of the castings required by Messrs. Gwynnes Engineering Company for their "Albert" car particularly, the business was converted into a private company, under the chairmanship of Mr. Nevile G. Gwynne, C.B.E., with Mr. Shannon managing director,

Fig. 1.—The Iron Foundry, Ealing Park Foundry.

Fig. 2.—The Core Shop, Ealing Park Foundry.

and Mr. W. Cannell, director, and to-day the Ealing Park Foundry is—save for a few minor details—the most modern and one of the best equipped in the London area.

The offices of the company front on to Junction Road, South Ealing, and the works are within

Fig. 3.—The Brass Casting Shop, Ealing Park Foundry.

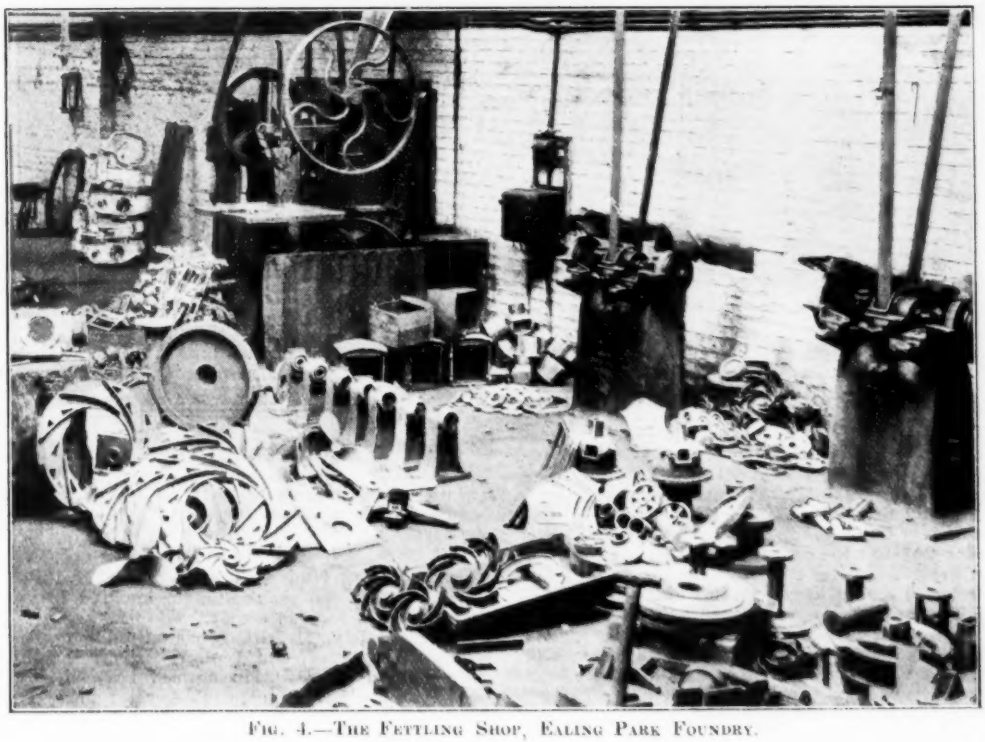


Fig. 4.—The Fettling Shop, Ealing Park Foundry.

approximately six miles of Charing Cross Station. The site of the works is bounded on the one end by Carlyle Road, and on the opposite end by Darwen Road, and this position has been turned to advantage in the layout, all raw material being delivered through gateway entrances on to the one road, and the finished castings loaded up for despatch from the other road, an arrangement which is naturally conducive to perfect continuity.

The stocking ground is immediately at the rear of the cupolas, a charging platform 36 ft. by 40 ft. is common to the two cupolas which, built by the Constructional Engineering Co., Birmingham, have each a melting capacity of three tons per hour. The charging platform is served by a 15-cwt. electric hoist (Brentside Engineering Co., Brentford). Blast is supplied by a Keith Blackman high-pressure fan, which is driven by a 20-h.p. motor.

The sand plant (nothing but Midlands sand is used) comprises a pan mill and pneumatic riddles.

The iron foundry is covered by a building 200 ft. by 40 ft., the floor of which is served by a Chatteris 4-ton electric crane.

There is a full complement of moulding machines,

comprising a No. 9 MacDonald turnover jar-ram, three No. 2 and six No. 0 "Britannia" jar-ram machines, Coventry squeezer, power squeezer (Leys Malleable Castings Co.), three Pridmore rockover drop machines, two International draw machines, and two Adaptable moulding machines. The whole of the machines are ranged at one end of the shop on either side of a central service bay. The foundry is served by a bogie charged drying stove, which is fired with town's gas. There is also an Augusts' coke-fired annealing furnace.

For the time being the core shop is housed in what will eventually be a jobbing foundry when the new core shop is completed. The present shop is 80 ft. by 25 ft. A separate bench is provided for each core maker, which is very necessary in a shop where such a large number of oils and cores are made. There are seven core stoves of various sizes, the largest one being provided with a charging carriage and one laid out entirely for special cores for cylinder work—castings for the motor industry being a specialty.

The brass foundry, which adjoins the iron foundry, occupies a building 75 ft. by 35 ft., and the runways carry a Herbert Morris 2-ton crane.

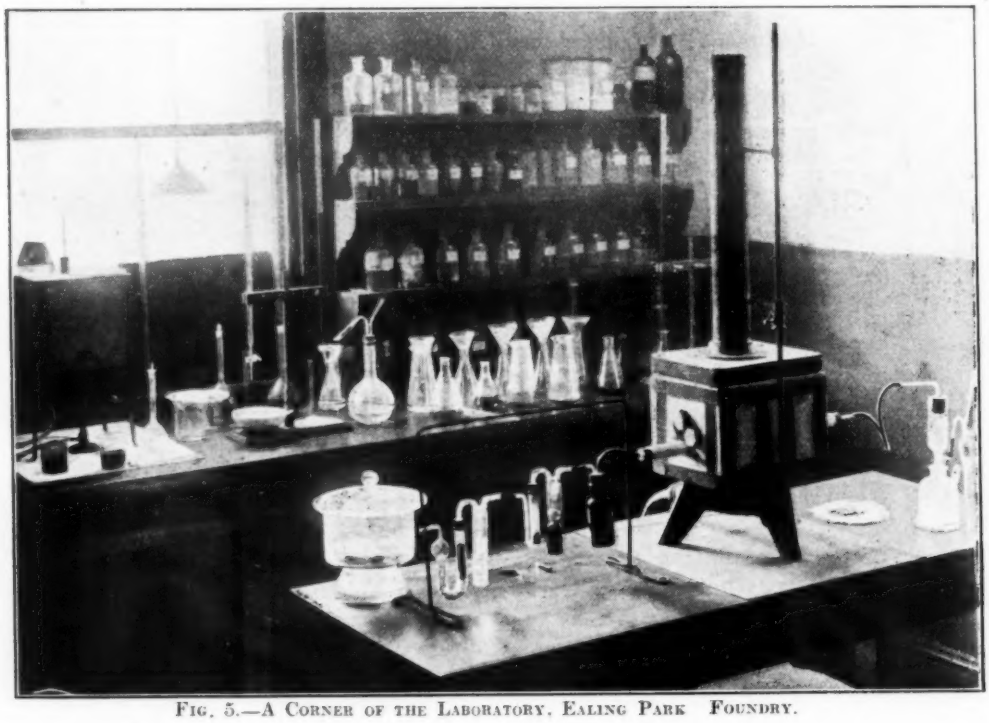


Fig. 5.—A Corner of the Laboratory, Ealing Park Foundry.

The machines installed include two No. 2 and one No. 0 "Britannia" jar-ramming machines, Coventry squeezer, and there are two pneumatic riddles.

The melting plant comprises two Morgan coke-fired tilting furnaces of 400 lbs. and 200 lbs. respectively; two 300 lbs. and two 200 lbs. Wright-Morgan gas-fired tilting furnaces, and three 100 lbs. pit fires, which last are worked with forced draught. Castings in non-ferrous metals are made up to 15 cwt. in weight. The iron and brass foundries communicate by bogie track direct with the fettling shop, in which are installed a Tilghman sand-blast room, whilst the equipment includes a git cutter, bandsaw, three large double grinders, four pneumatic hammers, tumbling barrels, etc. The air main for the pneumatic tools is laid completely round the shop.

There is a small but well equipped pattern shop and pattern stores. Catering for special industries the patterns are, of course, for the most part sent by the company's clients.

Power for the works is taken from the mains of the Borough of Ealing at 2,000 volts, 40 periods, single phase, and is transformed to 220 volts for lighting. For power purposes, however, it is converted to 220 volts D.C. For this duty there are two sets of rotary converters: 40 kw. Millns Electric Co., London, and a 30 k.w. B.T.-H. In addition to the electric power there is a Kynoch gas engine of 30 h.p., which drives a Lacy-Hulbert vertical compressor of 70 cub. ft. per min. at 80 lbs. Air for the gas-fired tilting furnaces is supplied by Bryan-Donkin low-pressure rotary compressor, capable of delivering 25,000 cub. ft. per hour at 3 lbs. pressure.

Air for the pneumatic tools is supplied by an Ingersoll-Rand compressor, delivering 200 cub. ft. per min. at 80 lbs. This is driven by a short belt from a 30 h.p. motor.

The necessity and importance of the metallurgical chemist in a modern foundry has also been fully realised, and in order that the company may supply to its customers reliable castings made under scientific control, a laboratory has been installed, complete with apparatus for analysis of all raw materials and with a modern microscopical outfit for the examination of metals. Physical tests are also provided for; all melting operations are controlled, tested, and recorded, and it is therefore possible for the company to supply their customers with iron or other metal to meet their particular specification, it being obvious that modern requirements cannot be met with certainty by the old "rule of thumb" methods.

The photographs illustrating this article have been taken by the works chemist, Mr. B. Liversidge.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

I.B.F. Propaganda.

Sir,—I have read with interest Mr. H. A. J. Rang's letter, and thank him for his kind invitation, which I hope to accept.

Unfortunately, Mr. Rang has missed the whole point of my letter, and I would suggest that his reference to the "world-renowned hospitality of the Tyneside" is an admirable, yet typical, expression of local patriotism. Now, sir, I respectfully submit that this spirit of *local* patriotism often permeates the *local* Press, with the result the *local* celebrities get the main publicity, to the detriment of the requirements of the Institution. In the report of one annual dinner (not Newcastle) two or three lines were devoted to the speech dealing with the Institution, while the trade and commerce of the district had quite a good show. It is in this direction where I wished my remarks to be constructive.—Yours, etc.,

"Interested."

Moulding a Lathe Bed.

By E. Longden.

Foundries which specialise in machine-tool castings have, as a rule, complete boxes, copes and drags in which to mould the majority of lathe beds. The following article explains the processes practised in the production of such castings of exceptional length, such as as shown at Fig. 1.

It is unnecessary to construct a full pattern. In this case two lengths of pattern are used, one piece about 10 ft. 1½ in. and the other 18 ft. 2 in. in length. After moulding so far as the pattern will conveniently allow, the short piece is withdrawn from the mould and used again at the other end of the mould, to give a total length of 38 ft. 5 in. A pattern is made very little different from the sketch of the casting shown at Fig. 1. The sections A and B are only loosely attached to the body of the pattern, located by pegs. On the pattern at C and D are fastened prints for cores which lighten the casting at these parts.

The tackle for moulding is that which is usually present in a foundry making heavy castings.

In Fig. 2 is seen a plan and sectional views of the assembled mould. The pattern is used the reverse way to position shown on the sketch, Fig. 1.

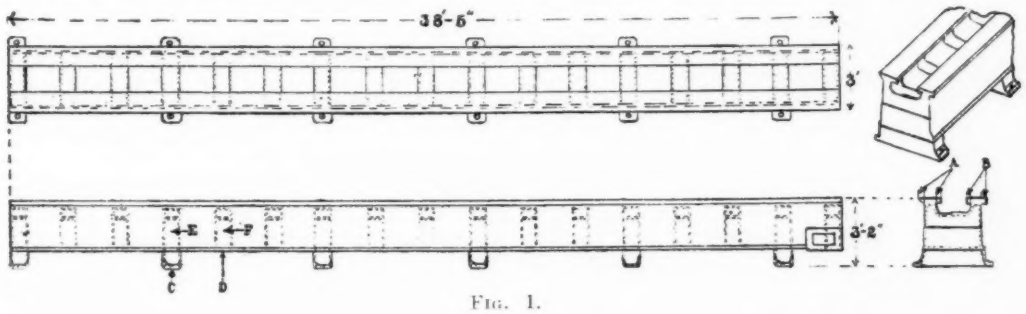


FIG. 1.

Operations are commenced by digging a hole 6 ft. 6 in. by 6 ft. 6 in. by 42 ft. Bars shown at A, Sec. F F, Fig. 2, are bedded and levelled in the bottom of the pit. Immediately on these are set either plates or grids B. To withstand the weight of the copes and the binding down operations, bearers A, Sec. B B, are set upon the plates, along the sides, at intervals of about 6 ft., and are built up during the ramming to come level with the top joint. C, Sec. F F, are bolts used for binding the mould together, and are next placed in position. 20 in. of solidly-rammed sand takes the job as far as the laying of a bed of cinders covered with hay or straw to prevent sand trickling among the cinders, thereby preventing free circulation and exit of gases. A number of vent pipes are set in the cinder bed, leading up to the joint face beyond the sides of the top boxes, as shown at B, Sec. A A. Black sand is solidly rammed upon the cinders to within about 2 in. of the bottom face of the mould and vents thrust through into the cinders below. To form the bottom side of the mould a face is struck, in facing sand, upon a series of strips, set to allow 1 in. of camber. Although, to commence with, the pattern forms only a little more than two-thirds of the mould, the whole of the bottom surface is at once prepared.

Fig. 3 is another cross-sectional view of the mould, and shows the manner in which the sides of the mould are built up. The pressure of metal and shape of the casting at A necessitates very skilled ramming. To ensure soundness at this point only enough sand is fed in, which, when consolidated, just reaches to the top of the flange. A row of short irons B are driven down, about 2 in. from the sides of the flanges, at intervals of about 3 in. along the whole length of the sides. Irons C are set to carry the sand over the flanges. Irons D are placed here and there to bind the sides of the mould together. Each batch of loose sand to be rammed can be increased until the last one reaches 6 in. in depth. Before feeding in black sand the facing sand should be rammed by flattening to the sides of the pattern with a bar constructed as shown in Fig. 4. It is bent so that it allows the moulder to strike the sand without injuring his hand on the pattern. The flattened surface thus formed is roughed up and needle-wire vented.

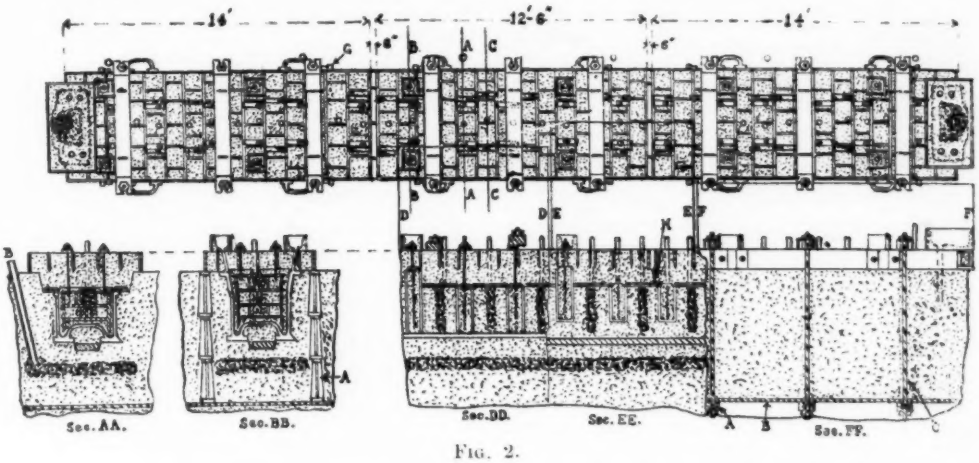


FIG. 2.

Runner gates are placed, as shown at Fig. 5, at each end of the mould. The in-gates are better formed in a core and laid when ramming. Down-gates, which are placed against the in-gate cores and reach to the joint face, are of larger capacity; these, again, are fed by runner gates leading through the copes, which are of slightly smaller capacity but larger than the in-gates.

The inside of the mould is made as shown at E, Fig. 3, and is so constructed that it can be lifted out to facilitate the extraction of loose pieces and dressing of the mould. Fig. 6 shows one of the lifting plates, which are also illustrated in section at F, Fig. 3. The total length of the mould is 38 ft. 5 in., which necessitates the use of three lifting plates, each about 12 ft. 9½ in.

long. Fig. 7 gives a view of one of these inside portions of the mould when lifted out and dressed. A tapered joint is made about 4 in. below the bottom face of the mould, in which must fit perfectly the lifting plates. As ramming proceeds irons are placed at right angles to the vertical bars cast in the plates to reinforce and lift the overhanging body of sand. Venting with cinders and the wire is carried out as in the making of a core.

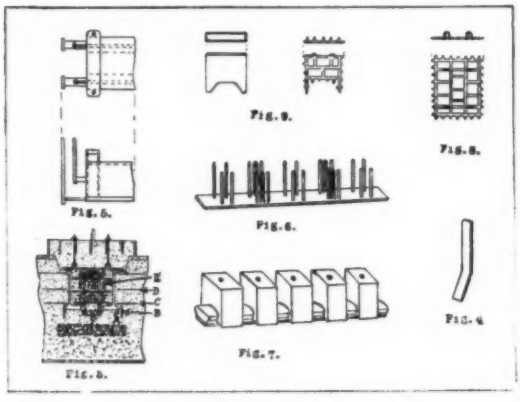
The top joint runs horizontally across the upper face of the inner mould, then rising to the top of the feet, followed again by another horizontal joint, upon which sits the copes resting on the bearers which have been built up during the ramming.

Before placing the copes into position grids, constructed as in Fig. 8, are set on facing sand, in between the feet, vent pipes, which are to conduct away gases from the cores; and inside of mould, are set; pegs laid in to form holes for the hook bolts on which are hung cores, and the mould rammed to the top joint. In turn the copes are put into place, riser pegs set on the feet, rammed, and the grids firmly bolted up.

The top parts are located by stakes G, Fig. 2. Where they meet a diagonal joint is made, as shown at H, Sec. E E, Fig. 2.

The cope which covers the short piece of pattern at the end is first lifted off, pattern withdrawn, and, after small alterations, fixed in position at the other end of the mould on the bottom surface already made. Gates are adjusted and the mould constructed as before described.

After the copes have been taken off, dressed and stoved, the pattern is withdrawn. The plates, on



which is built the interior of the mould, are next lifted out, finished and stoved. Moulders now have access to that part of the mould remaining in the floor. Loose pieces are taken out, the name of manufacturer stamped on the sides, and the mould dressed and fired.

Sketches of the core iron and cores which form the interior of the casting at E and F, Fig. 1, are shown at Fig. 9.

The assembling of the mould will be clearly seen. Cores are fastened in the top parts, inside portions set, and the mould closed down by the copes.

Various types of binders are used, and a simple one will suggest itself to any practical moulder.

Fig. 2 shows positions of runner and riser basins. Ball stoppers should be placed in cup-shaped cores forming the tops of the down-gates. When pouring, the stoppers covering the gates leading to the bottom of the mould, are first raised, allowing about 4 tons of metal to pour through, the remaining stoppers are then lifted, allowing a rapid filling of the mould from a higher level.

Distortion and straining of the casting is counteracted by camber, freeing of risers, runners and feet, and the making of grids which are used to lift the mould in between the feet with serrated sides, the sharp points offering little resistance to the contracting casting. Sometimes holes are dug under the centre of the casting to expedite the cooling of that part of the casting which remains hot the longest and contracts last.

The metal used should possess those constituents in quantities which will give a good hard-wearing material.

Foundry and Pattern Shop Harmony

By F. C. Edwards.

Nothing is more common in life than to find individuals and bodies of men, with identical interests and complementary functions, acting towards each other in a spirit of hostility. This may be justified by Spencer's dictum, that "Society flourishes by the antagonism of its atoms." In this case, we are entitled to ask: "What becomes of the atoms?" What if they dispute the dictum, and by their conduct expose its fallacy!

Regarding pattern shop and foundry as contiguous atoms, it must be admitted that they lend support to the dictum; for perfect harmony between these departments is somewhat rare. This is, however, more significant than strange, as a little consideration will show.

In the whole range of industry, foundry and pattern shop hold perhaps a unique position: (1) With regard to their close reciprocal dependence; (2) the extreme dissimilarity of their respective operations; and (3) their high and extensive technicality. In each the training must be both thorough and comprehensive. There is no place for make-believe. The use of tact, which in some professions—law, for instance—is highly cultivated, is mostly ignored or openly deprecated. Consequently, unless the heads of these departments are naturally broad-minded, misunderstandings easily arise and may lead to a chronic state of strained relations.

The more intense and complete the special technical training of the individual, the greater the likelihood of such misunderstandings. Absence of mutual agreement is, therefore, no sure sign of incapacity on either side. On the contrary, it often denotes special capacity. At the same time it proves absence of tact, and accentuates the need for the exercise of the fullest measure of mutual tolerance.

There is a well-known saying that the best workmen seldom make good foremen. This remark usually contains the innuendo that a certain foreman was incompetent as a workman, with the inference that his judgment is unsound. The axiom has often been proved to be true by the test of experience. It is also in accordance with the teachings of psychology. How can a mind that has become habituated to an absorbing interest in the details of one job be expected easily to adapt itself to general views on many?

By analogy it may be assumed that a too-complete study of strictly departmental problems militates against the true solution of interdepartmental ones. Experience supports this assumption, and points to the necessity for cultivating the power of subordinating one's own narrow direct interests, when occasion demands, to promote unification of the whole.

Foundry and pattern shop being very distinct, though highly complementary, departments, their respective managers have a specially hard task to secure neatness of fit with absence of friction. Flexibility, with a spirit of give and take, will prove, however, to be an excellent corrective, and is perhaps the only means of ensuring harmony.

Publications Received.

Third International Industries Fair of Spain. Itinerary and particulars of a fifteen days' escorted tour to "Sunny Spain," visiting Barcelona, Montserrat, Valencia, Madrid and San Sebastian, organised by the Spanish Travel Bureau, 11, Queen Victoria Street, London, E.C.4.

"Industrial Welfare." February, 1922. Monthly, 9d. Head Offices, 51, Palace Street, London, S.W.1.

"A.P. Pennings," the brightly-edited house journal of the Avenue Press (Messrs. Upcott Gill, Limited), 55-57, Drury Lane, London, W.C.2.

"Anglo-Swedish Trade Journal," January, 1922. Published by the Swedish Chamber of Commerce, United Kingdom, 14, Trinity Square, London, E.C.3.

"The Swedish Year Book, 1922." Price 7s. 6d. net. Published by A. B. Teknologforeningens, Forlag, Stockholm. London: Williams & Norgate, 14, Henrietta Street, Covent Garden, W.C.

Oilsand Cores.*

By J. Masters, of Stockport.

By whom and when oilsand cores were first used there is no definite data, and no one seems to desire the credit for this really great boon to foundries generally. Various kinds of materials have been used in conjunction with sand for making cores, such as treacle, resin, flour, linseed meal, boiled linseed oil, boiled potatoes, glue, bitumen, and many kinds of gum, and even stale beer. All were used with the object of introducing better cores and no doubt in some cases very good results were obtained.

Generally speaking, these materials were either too expensive or took too long in preparation to become of real value to foundrymen, and often gave such varying results that only on special occasions were they used. During the war methods designed for giving the maximum production were adopted, sometimes regardless of cost; but, however, the experience gained can now be applied to general foundry practice, more especially so in these abnormal times. What is most astonishing is the small number of foundries which use oilsand cores, except for small round or slot cores.

There are many kinds of core oils and compounds on the market, and the proportions used vary according to the quality and the nature of the castings for which the cores are required. Great benefit is derived from using oil with loamsand mixtures, as not only are stronger cores obtained, but new material can be reduced to a minimum. This, however, is only necessary when the cores are of such design as to be difficult of preparation in seasand and oil, and for exceptionally large cores.

When using oil with sand alone, the best results are obtained by employing a sand of high silica content, and the finer the state of division the better.

Advantages of Oilsand Cores.

Numerous advantages are claimed for oilsand cores, amongst which are: (a) The increased number of cores produced; (b) the small amount of grids, vents and irons required; (c) the ease with which the cores are removed from the castings; (d) the ease with which the cores are dressed and blacked (where blacking is necessary); (e) the small number of broken cores returned from the moulders when closing their work; and (f) the small number of blown castings from the core point of view.

In claiming these advantages it should be pointed out that oilsand cores do not solve all troubles that can be associated with the subject, but there is no doubt that by their use many difficulties are overcome.

Disadvantages of Oilsand Cores.

Disadvantages are also encountered, the chief being that large-sized oilsand cores will not stand handling when "green." Additionally, there is the offensive smell given off from the cores during drying and after casting, and unless really good ventilation is provided such complaints are quite justified, especially where fish oils are incorporated. Recently a few firms have conducted research work with the object of preparing an ideal compound, and have been successful in putting on the market an oil which is free from obnoxious smells and which will mix readily with the sand.

Linseed oil has often been quoted as the finest binder, and very remarkable results have been obtained by its use. This oil, however, has certain drawbacks, and if left to stand after being mixed will be found to "film," and is not easily mixed with the sand. This material also gives off unpleasant smells during drying and after casting. It further causes the eyes to smart where there is much cored work. Additionally it is fairly expensive.

Thorough Mixing Essential.

In all oilsand mixtures it is essential to watch carefully the thorough mixing of the required proportions, which vary from 30 of sand and 1 of oil to 60 of sand and 1 of oil, the governing factor being the class of work to which such cores relate.

Where heavy sections are encountered a slight addition to the oil content will be found beneficial.

It has been stated that oilsand cores will not readily take blacking, but during the war several thousands of 112-lb. aerial bombs were made and were blacked in a specially made bath by dipping and subjecting the cores to just a couple of revolutions. Each day 120 cores were used and blacked. They were in just over one hour, and whilst rejects were very low throughout, none were due to core troubles, and this in spite of the fact that only female labour was employed. To assure success the cores must not be too hot when blacked, or the blacking is liable to "bead" or "blister." It is also essential to have the best assistance from the pattern shop, and in cases where jobbing work is undertaken an understanding must be arrived at as to how the coreboxes are to be made.

Oilsand cores are particularly applicable to any type of valves. The method adopted is to make one half of the core, stove it, and to use the dried core as a support for the wet half. Before jointing a thin coating of gum will ensure a tight fit. In the case of large heavy cores, where an iron is necessary, the half-dried first should contain the iron and be placed in the mould. Where cores are of an irregular character, which in the ordinary way would necessitate much preparation in the way of making core-irons, it is often possible to part the core on a plain section and proceed as in the making of large valves.

Wherever possible the coreboxes should be made by constructing collapsible frames with rebatted ends, held together by bolts and winged nuts so that heavy rapping is eliminated. Where undercuts are encouraged, which would ordinarily require some support, a slab of oilsand core can be cut to suit and, given a reasonable bearing, will act better than ironing. When such cores are dried they will not be easily separated.

It is sometimes thought that oilsand will not ram, but by using a rammer with a large head surface much better cores are obtained. These rammers are sufficiently heavy if made of wood, if the larger cores are finally rammed with the usual style of flat rammer.

Jacket Cores.

In making jacket cores it is necessary to have a ready outlet for the gases generated during casting.

For this purpose it has been found that the best results are obtained by using strands of straw. The use of tapers and wax-wire-vents, introduces a liability of the core in the locality of the vent to be soft, and there seems to be no combination between the oil and the melted wax. This may not be so apparent in cores that are extremely well dried, but in giving oilsand cores much more heat than is necessary the binding power of the oil is reduced, and becomes dangerous. As jackets and ports are often comparatively thin cores, it is best to retain all strength possible.

In making jackets where a reasonable vent is desirable provision is made to joint the cores after being dried. Before jointing the halves are tried together and after ascertaining that size and fit are satisfactory, a deep ricket is cut along the joint to catch the straw strands. The two halves are thin gummed, and either wired or bolted together. The results obtained from oilsand cores in general jobbing work are consistently good. Cores varying from a fraction of an ounce to upwards of one ton have been used in castings weighing upwards of 20 tons. A slab of oilsand used in the bottom, or on the side of a mould rammed up in position for supporting a stud or chaplet will carry a great amount of weight without yielding. Again, in such castings as heavy bedplates for engines of heavy machinery where there is a diamond or chequer pattern on the bottom of the mould which would under ordinary conditions require much sprigging and venting all that is necessary is a sectional slab-box about 1¼ in. thick and a print on the pattern.

The Usefulness of Slab Cores.

The slab cores can be sprigged or otherwise fastened in the bottom of the mould, and drying is eliminated and scabbing or warping reduced to a minimum.

* A Paper read before the Burnley Section of the Lancashire Branch of the Institution of British Foundrymen on Feb. 9.

Where castings are of such design as to set up abnormal contraction strains, oilsand cores are invaluable.

As soon as the metal is set, beyond retaining the heat, these cores are absolutely friable and offer no resistance whatever to the contraction, and if it is necessary to get the core out a few touches on the core with a light bar is all that is required. Oilsand cores can be rubbed or sawn to any shape without losing their smooth surface, as their structure is absolutely uniform. Different opinions exist as to whether the sand should be dried before use, or, in the case of sea sand, used as received.

In the author's foundry the sand is kept under cover, and used without drying, and gives no cause for complaint.

Suitable Mixtures.

Firms, having facilities for drying sand previous to use, the following mixture will be found to be satisfactory: 1 part oil, 9 parts water, 45 parts seasand. It is preferable to err on the side of wetness than to work the mixture too dry.

The author uses the sea sand received, and mixes the oil content thoroughly in the sand, and then adds sufficient water to give the required consistency. If the water is added first it is much more difficult to get a thorough mixture.

The heat required to dry oil-sand ores is governed by the size. In most cases just slightly more heat is required than would be necessary for loam-sand cores of the same size.

Loam-sand mixtures for any work can be made better if a small amount of oil is added.

In mixing blackings for heavy work, especially where the moulds are blacked whilst green and sleeked, a mixture of one pint of oil to two large buckets of blacking is very beneficial, and will prevent the blacking running after drying.

Where Oil Cores Fail.

By F. C. Edwards.

No simple agent of production has effected a greater revolution in foundry practice, and none is more universally applicable—nor more certain to become solidly established wherever it is given a trial—than the oil-sand core. The reason is not far to seek, for the inherent superiority of the oil core over the ordinary dry-sand core is distinctly shown in what are, perhaps, its three principal features, namely:— (1) Ventilation channels are, as a rule, unnecessary—an obvious advantage, especially with intricate cores; (2) when dry, the cores possess a peculiar firmness and tenacity, which enables them, however light in section, to withstand considerable handling without fracture. This property obviates the necessity for stiffening-rods in all but the longest cores. (3) The core is removed from the casting without the slightest difficulty, leaving a smooth surface. The latter

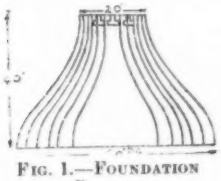


Fig. 1.—Foundation Block.

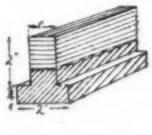


Fig. 2.—Tee-shaped Core

quality is due to the steady and continuous blanket of gas evolved when the core is exposed to the high temperature of the molten metal. This is a similar action, of course, to that which takes place in the case of an ordinary dry-sand core or mould, coated with blacking. In the former case, however, the whole body of the core is impregnated with the carbon-carrying oil. Its capacity for yielding the inflammable gases required to form a separating blanket is, therefore, not confined to its surfaces. It may, indeed, correctly be regarded in the light of a reservoir, to be drawn upon in proportion to the intensity and duration of the heat to which it is subjected.

The fact that oil cores fall away from the casting as fine dust proves, of course, that the binding material has been completely removed by the heat of the molten metal. This is significant, and points to a danger that may not be generally realised.

Briefly, with all its obvious advantages, the utility of the oil core is limited to its power of retaining enough of the inflammable binding material for its own support until after the metal that surrounds it has set.

Clearly, since the oil is the sole binding material of the core, therefore when an exceedingly small core is partly surrounded by a huge mass of molten metal, a point is reached where the core, every vestige of inflammable material, *id est*, binding matter, having disappeared, and still subjected to the disintegrating influence of the molten—and probably moving—mass of metal, can no longer hold together, and it collapses.

This result is sometimes startling and costly, as was demonstrated by a case with which the writer was personally connected during the war. A number of foundation blocks, weighing several tons each, shown in Fig. 1, were required. About a dozen small tee slots, with dimensions shown in Fig. 2, were to be cast in the top of each block. The job was moulded, of course, in an inverted manner to that shown in Fig. 1, and oil cores were used.

When the first casting was dressed the slots could scarcely be found. The tee portion of the cores, shown sectioned in Fig. 2, had completely disappeared.

A little investigation proved that the cores had been properly secured, and the job had been "run" in such a way that the possibility of the cores being washed over as the metal entered the mould was that the intense and prolonged heat of the great mass of metal had brought the cores to the condition described above. Disintegration and dissipation followed, leaving little more than the portion supported by the point as evidence that they had been placed in the mould.

For the next casting the tee-cores were made from strong, ground red sand, and contained no floor-sand whatever. They were given three coats of blacking, so as to enable them to keep up the protective blanket of inflammable gas especially required by the circumstances.

The result was quite satisfactory, the slots being quite clean and sharp. The refractory nature of the cores so made, along with the specially-thick coating of blacking, had enabled them to withstand the intense heat without disintegrating. No further trouble was experienced with the remaining blocks. The conclusion previously formed regarding the cause of failure with the oil cores was thus fully substantiated.

The Appearance and Behaviour of Titanium in the Pig-Iron Mixer.*

The magnesite lining of a pig-iron mixer showed a coating of a clear copper-red colour, consisting of minute cubical crystals. This crystalline skin was not in contact with the magnesite, but rested upon an intermediate layer of iron, to which it was strongly attached. A sample of the whole mass was carefully analysed. The analysis presented some difficulty, owing to the firm adherence of the crystals to the iron; but it was ascertained that this intermediate layer of iron contained a higher proportion of sulphur and manganese, and that the crystals consisted of a combination of carbon, nitrogen, and titanium similar to that in the cubes which Wöhler discovered in his blast-furnace investigations. The processes followed in this inquiry are fully described. The explanation suggested is that the titanium compound is dissolved by a layer rich in sulphides, which is formed between the iron and the slag. This layer, which is doubtless the uppermost of the mixed pig-iron, solidifies more quickly than either the iron or the slag, and it may, therefore, solidify in the joints of the mixer as the emptying of the latter proceeds. During this cooling and solidification the nitrogen-titanium compound in solution in that layer crystallises out. The crystals in question rest, as stated above, upon a base of iron rich in sulphur. As a rule, this layer is removed with the slag. It is improbable that a gaseous combination of titanium and carbon takes place in the pig-iron, and then, in contact with air, carbon-nitrogen-titanium forms. The origin of the titanium was probably the Swedish ore used.—B. Osann. (*St. und Eis.* 41, 1487.)

* Institution of Civil Engineers Abstract.

The Early History of Iron with Special Reference to Cast-Iron.*

By J. Newton Friend, D.Sc., Ph.D., F.I.C. (Carnegie Gold Medallist).

The story of man's progress from the earliest dawn of human intelligence to the present day shows how, partly as the result of experiment and partly by force of circumstances, he has been led through the early Stone ages to the discovery of metal; how the metals came to be differentiated, and how great an impetus was given to the onward march of civilisation by the comparatively modern discovery of cast iron and of the manifold uses to which it may be put.

The Stone Age.

At the dawn of the human era, when man was just emerging from the brute creation and depended for his very existence upon the skill with which he could defy and repulse the attacks of animals more powerful than himself, he would seize upon any stones, branches of trees, or other hard materials lying at hand for purposes of offence or defence. As years rolled by he would learn to prepare in moments of quiet for future emergencies, and would thus single out stones, etc., which appeared to him specially suitable for the purpose, and keep them by him, just as we read that David, thousands of years later, "chose him five smooth stones out of the brook" prior to his engagement with the gigantic Philistine. Later on it would occur to him to improve upon

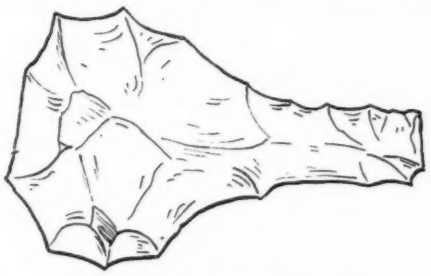


Fig. 1.—A Paleolithic Flint.

the natural shapes by chipping, and he would soon discover that flint is particularly amenable to such treatment. His earliest attempts would be crude, and ofttimes his implements would scarcely be distinguishable from chance products of nature. Such stones are termed *eoliths*,† and have been the subject of many discussions by various antiquaries, some postulating human agency, and others denying it.

Gradually man became more efficient, and his implements began to bear such decided marks of skilled workmanship that no longer can any doubt remain as to their origin. These stones, still crude and rough (Fig. 1), are known as *paleoliths*.‡ These were of several types. Some were flint flakes, probably for use as knives or arrow heads, and were chipped from a suitable lump of flint in directions parallel to the cleavage planes either by blows or by pressure. The point of application of the force can sometimes be seen. The residual centre portion of flint is termed a *core*, and some of these, together with the flakes detached from them by paleolithic man, have been discovered at various times; they present an appearance not unlike that shown in Fig. 2.

In course of time the shaping of flint implements became a highly developed art. Tools of exquisite workmanship were frequently evolved. This was particularly the case in Egypt, where the flint knives that date back to just a little before the First Dynasty, *circa* 4400 B.C., are described§ as "undoubtedly the most remarkable stone weapons ever made in the world." Such stones are termed *neoliths*,¶ and the not confined to flints, but comprise numerous other stones, such as quartzite, jade, and even Cumberland hematite. These were rubbed or ground to shape and polished as shown in Fig. 3. Some of the knives were even curved like a sabre, and the arrow heads were ofttimes beautifully symmetrical. Some of these are known in country districts

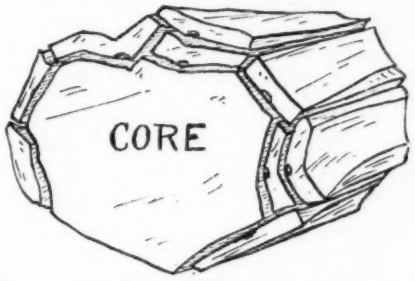


Fig. 2.—A Paleolithic Flint Core with Flakes.

at the present time as *elf-shot*, a name that explains itself, and, mounted in silver, they were worn some years ago as charms against poison, witchcraft, and the like.

Neolithic men were great builders, and it is to them that we owe such wonderful stone circles as exist at Stonehenge and elsewhere. That at Stonehenge probably dates back to about 1800 B.C.

During his wanderings in search of suitable stones early man occasionally stumbled across native metals, such as copper and iron, the former terrestrial, the latter in most cases meteoric. Finding that they did not crack on being hammered,* that they possessed great tenacity and admitted of being rubbed to a fine, hard edge, he would greatly prize them, and pieces would be handed down from father to son as valued heirlooms. This does not constitute the beginning of what antiquaries term the "age of metals," for man, at the period of which we speak, had no idea of the connection between native metals and the earthy ores around him. He regarded the metal as a particularly useful and, unfortunately, rare kind of stone, and probably there the matter ended in so far as he was concerned.

Fig. 3.—A Jade Adze.

In the neighbourhood of Lake Superior, where large masses of native copper occur, there have been unearthed at various times axes, lance heads, and other primitive implements composed of this metal, all shaped by hammering. The Indians of the North Pacific Coast had learned to utilise the deposits of native copper in the Chilcat

* A Paper read before the Birmingham Branch of the Institution of British Foundrymen on Dec. 14.

† Greek *eos*, down; *lithos*, stone.

‡ Greek *palaios*, ancient.

§ King and Hall, *Egypt and Western Asia in the Light of Recent Discoveries*. S.P.C.K., 1907, p. 14.

¶ Greek *neos*, new.

* Even meteoric iron can usually be cold worked. See Zimmer, *Journal of the Iron and Steel Institute*, 1916. No. II., p. 306.

country north of Sitka on the Isle of Baranof, and the copper shields made by them travelled down the coast to Queen Charlotte's Island.*

The same kind of thing has been repeatedly observed also in connection with other metals by travellers within historic times. Sabine, who accompanied Ross in his Arctic explorations in 1818, relates that certain Eskimos, who visited the party, carried knives consisting of blades, of what was afterwards proved to be meteoric iron, set into bone handles. The pieces of iron had been detached with great labour from the softest of three masses of metal of meteoric origin at Melville Bay, and had then been beaten flat between stones in the cold condition.

This undoubtedly represents exactly what primitive man would do in Europe ages ago. It has been suggested that, in so far as iron is concerned, the amount of meteoric iron on the surface of the earth is so small that early man would probably seldom have an opportunity of seeing any, and only in rare cases would he ever have used it. There is more meteoric iron known to science, however, than many people believe. Zimmer estimates its amount at approximately 246 tons, and in the days of prehistoric man there were all the accumulations derived from meteoric showers of the previous ages to draw upon. Hence, it is reasonable to suppose that meteoric iron must have been rather more plentiful than now, particularly when it is remembered that, owing to its nickel content, celestial iron is frequently highly resistant to corrosion.

The Age of Metals.

Many centuries elapsed, perhaps indeed ages, before man discovered that certain "stones" on being heated in the fire yielded a new "stone" capable of being hammered into useful shapes, and differing from the original stone in most of its other properties. This new product is now called copper or bronze, according to its composition. At first, no doubt, it was a matter of accident whether bronze or copper was produced, a "natural" alloy resulting from the reduction of the particular ore at hand. Thus, as Gowland† points out, "in Hungary, where the copper ores are associated with antimony ores, the early implements contain antimony up to 4½ per cent., an alloy resembling bronze in many of its physical properties. Similarly, implements in Ireland and Egypt sometimes contain 2 to 4 per cent. of arsenic, and in Germany from 2 to 4 per cent. of nickel. In England, where copper and tin ores are so commonly associated—as in Cornwall—the earliest implements are of bronze. . . . . Owing to the non-discovery of tin, or copper ores containing it, in early times in Ireland and their absence in Cyprus, the implements of the Early Metal Age in these localities are of copper, and this at a time when Central Europe was in the Bronze Age." Ultimately, however, it would be observed that the bronze was not a simple substance, but a mixture, and in this manner metallurgical knowledge gradually progressed both during and after the transition of man from the Stone Age to the "Bronze Age."

Very considerable metallurgical skill was ultimately attained, and eventually iron ores were reduced to the metal and an iron industry was established. This simple beginning heralded the dawn of the "iron age." The greater strength of iron, when once this metal had been isolated, would lead to the gradual replacement of copper and bronze for many purposes. Lucretius,‡ writing about the year 56 B.C., describes this transition with characteristic elegance when he says:—

"With copper§ they would belabour the soil of the earth, with copper stir up the billows of war and deal about wide gaping wounds and seize cattle and lands; for everything defenceless and unarmed would readily yield to them with arms in hand. Then, by slow steps, the sword of iron gained ground, and the make of the copper sickle became a byword; and with iron they began to plough through the earth's soil and the struggles of wavering war were rendered equal."

But not every nation had its bronze age. Just as copper did not in every case precede bronze, so iron was not in every case preceded by either of these metals, in Africa,* for example, excluding Egypt, man passed direct from the age of stone to that of iron. The same was apparently the case also in Southern India.†

Evidently, therefore, the particular path by which man has advanced has been governed largely by natural circumstances, different countries and different tribes being ofttimes led by different routes. This may be represented by the following scheme:—

Stone Age
- → Copper Age → Bronze Age → Iron Age
- → Bronze Age → Iron Age
- → Iron Age

The question now arises as to how many years iron—whether native, meteoric, or manufactured—has been known to and used by different peoples.

In attempting to find an answer, it is important to bear in mind that the term "age" in the above scheme refers not to a period of time, but to a stage of civilisation. Just as the nations to-day differ in the relative degrees of their civilisations, so in past ages some of the peoples were living in their stone age, whilst others were using implements of bronze, and yet others had become familiar with iron. Thus, Britain was passing through her stone period at a time when iron was already known in Assyria, in Egypt, and probably also in China.‡ Again, the inhabitants of Thessaly continued to use their stone weapons and their peculiar native pottery long after the culture of the bronze age had penetrated into Crete and Southern Greece. They persisted in their use, indeed, until the Cretan bronze age culture had reached its decadence, and the time for the introduction of iron had practically arrived.§ Similar variation in the grades of civilisation occurred even in one and the same small country, for means of communication were primitive or non-existent. Our own island is a case in point. At the time of the Roman invasion, 55 B.C., the Southern tribes used both bronze and iron implements, whilst the Brigantes in the north were still in their stone age.

Further, in the history of any one tribe or people it is seldom that a hard and fast line can be drawn between the stone, bronze, and iron ages, for these gradually merged the one into the other. During the early days of the bronze age tools and weapons of that metal were used alongside those of stone. Nor could iron, at the date of its discovery, be expected to supplant immediately and completely its predecessor.

An interesting example of this transition is afforded by a dagger found in the River Witham.¶ The lower part of its sheath, which was of bronze, is slightly decorated with regular Late Celtic ornament—which fixes its period. The blade is of iron and the hilt of bronze, illustrating the overlapping of these two metals. Such examples are not common in England.**

In the prehistoric remains at Hallstadt, in the Austrian Tyrol, and at numerous other places, implements of iron and bronze have been found lying side by side, further illustrating this transitional period.

In addition to these natural periods of transition between the ages of stone, bronze and iron, during which the various peoples were being educated to more advanced stages of civilisation, there exist what may be termed artificial periods of transition. These may be temporary and due to the force of local circumstances. Such was the case, for example, at the Battle of Hastings in 1066, when many of the Saxons fighting under Harold's banner wielded stone hammers, probably on account of the temporary shortage of iron. Religious conservatism accounts for the persistence of many old customs. Thus the ritual knives of Joshua v, 2, were made of flint, as the employ-

* Ridgeway, *The Early Age of Greece* (Cambridge University Press, 1901). Vol I., p. 595.
† Gowland, *Huxley Memorial Lecture for* 1912, Royal Anthropological Institute of Great Britain and Ireland.
‡ Lucretius, *De Rerum Natura*, translated by Munro (Routledge). Book V., lines 1250–1316.
§ *i.e.* Bronze.

* Gowland, *loc. cit.*
† Vincent A. Smith, *Journal of the Iron and Steel Institute*, 1912, No. I., p. 183.
‡ See Brough, *Journal of the Iron and Steel Institute*, 1906 No. I, p 233.
§ Hall, *Ægean Archeology* (Warner, 1915).
¶ Clinch, *Handbook of English Antiquities* (Gill, 1905).
** Reginald A. Smith, *A Guide to the Antiquities of the Early Iron Age*, British Museum, 1905.

ment of metal would have been irreverent. Herodotus,* writing about the year 450 B.C., mentions that the Egyptians when embalming their dead removed the brain by means of an iron tool, but, in order to remove the contents of the abdomen, they cut "along the flank with a sharp *Ethiopian stone.*" The use of iron for the one operation and stone for the other is interesting, the employment of the latter implement being evidently connected with religious ceremonial. The same explains the use of stone altars in our churches to-day, these being the modern representations of the stone altars used by neolithic man when worshipping his gods, as for example, at Stonehenge. An interesting example of individual conservatism is given by Mariette† and by Maspero‡, both of whom were acquainted with a Copt in charge of the excavations at Abydos. This man continued to shave his head throughout his life with a flint razor; as his scalp was scraped nearly raw by the operation he was wont to cover his head with fresh leaves to allay the irritation of his inflamed skin. He died when over 80 years of age in 1887, and was still wedded to his stone razor.

Iron in India.

Iron was known in India at a very early date. If the *Black Yajuveda* may be believed, it would appear that some form of iron cannon, or perhaps more correctly "engine of war" was in use between 2000 and 1000 B.C., say 1500 B.C.§ Between 500 and 200 B.C. iron appears to have been in frequent use, particularly for military purposes. Iron has long been credited with the power of warding off evil spirits, and the famous pillar at Delhi,‖ composed of this metal, has received no little worship. It dates back to about A.D. 300. It is 23 ft. 8 in. in height, 22 ft. being vertically above ground and 20 in. below. Its upper diameter is 12½ in.; its lower 16½ in.; whilst its total weight is approximately 6 tons. The legend connected with this famous pillar asserts that the metal had been driven so deep into the ground that it had pierced the head of the king of serpents, the god Schesnag, who supports the earth. It had thus a remarkably sure foundation. A Rajah doubted this, and ordered the pillar to be dug up, with the result that its end was observed to be moist with the serpent's blood. On attempting to replace the pillar, however, it was found impossible to transfix the wily reptile, and the pillar, in consequence, remained loose and shaky, symbolic of the Rajah's faltering faith. It has been suggested that the name Delhi is, in consequence, a corruption of a Hindoo word *Dhili*, loose, but a Hindoo Judge informed the author that more probably the name means "Heart's Delight," and is in no way connected with the pillar. The pillar is by no means shaky, however, but, according to Miss Gordon Cumming,¶ "is now as firm as a rock, and has even resisted the cannon of Nadir Shah, who purposely fired against it. The marks of the cannon balls are clear enough. Hindoos believe that so long as this column stands the kingdom has not finally passed from them. The pillar is a magnificent example of early forging. It was made by welding together discs of iron, the marks of the welding being plainly visible.**

A remarkable feature of the pillar is its freedom from rust. This is no doubt due to some peculiarity of its surface layer, for pieces broken away appear to rust with ease. Hadfield†† analysed one such sample and found it to contain :—

C=0,080, Si=0,046, S=0,006, P=0,114, Mn=0,000.

The high phosphorus and low carbon, sulphur and manganese contents, all tend towards reduction of corrodibility, but do not suffice to explain the general immunity of the pillar from corrosion.

Another iron pillar stood at Dhar, or Dhara, but is now in three pieces, measuring 24, 12 and 6 ft. in length respectively; a fragment is missing. The total length thus amounted to at least 42 ft., so that originally the column would be double the height of the Delhi pillar. Mr. Vincent A. Smith,* in describing the same, points out that "whilst we marvel at the skill shown by the ancient artificers in forging the great mass of the Delhi pillar, we must give a still greater measure of admiration to the forgotten craftsmen who dealt so successfully in producing the still more ponderous iron mass of the Dhar pillar monument, with its total length of 42 ft., which, like the pillar at Delhi, is of the Gupta period, or about the year 321 of the Christian era."

These are the only known large masses of iron in the world, and it is only within comparatively recent years that moderns have learned to deal with masses of iron approaching these in size. The question has been raised as to whence India derived her knowledge of iron. Babylon is suggested,† and it is well established that from very early times iron has been known in what is now Mesopotamia. Others suggest that the Hindoos discovered iron themselves.‡ This is very reasonable. There is, of course, no need to attempt to trace back the discovery of iron to one source. Just as at the present time discoveries are not infrequently made simultaneously in different parts of the world, so it is reasonable to suppose that in early days, when means of communication were slow and primitive, different nations or tribes may have simultaneously unravelled certain of Nature's secrets quite independently.

(To be continued.)

Book Reviews.

"DIE PRESSLUFTWERKZEUGE." By P. Iltis. Berlin: Walter de Gruyter & Company, Genthinerstrasse 38, W.10. (Price 1s. 6d.)

This is another little volume in the Göschen Collection and deals with pneumatic tools. Tools with rectilinear motion are first discussed in two sections according to their action by percussion and steady pressure, including moulding machines and electro-pneumatic hammers. Tools with rotary motion are considered next under the headings of drills and lifting devices. Another chapter is devoted to sand-blast plant for cleaning castings and to apparatus spraying paint ("aerostyles"). The author pays special attention to the economic aspect of using pneumatic tools and compressed air apparatus generally. The book, which has now reached a second edition, is fully illustrated.

"LEXIQUE TECHNIQUE ANGLAIS-FRANCAIS." By G. Malgorn. Paris: Gauthier-Villars et Cie, 55, Quai des Grands-Augustins. (Enhanced price 20 francs.)

This is a modest publication attempting to cover a very wide sphere: machine-tools, internal-combustion engines, electricity, shipbuilding, metallurgy, etc., all this on 216 pages, and without illustrations. The author, a naval officer, had to make technical translations from the English, but was unable to find a suitable dictionary of recent date; so he set to work and compiled one himself, embodying some notes of M. Desmarets collected for the material under letters A to E. We live and learn. "A," we are told, is an abbreviation for "Ampère," which is perfectly correct, but only in the form: "k.v.a.," and "ampere-volt" is not a "watt" in the case of alternating currents; hence the distinction between kw. and k.v.a. "Blank" is certainly a "lingot d'acier fondu" in certain cases, but not a general term for ingot. Then we have the compiler's authority for the statement that "civary" is the English for "pan de voûte." A "degging machine" is a "machine à humifier." Then "dedendum," "dedendum circle," "dedendum line," are terms used in connection with cogged wheels, etc. We have come across the word "dedendum" in the writings of authors (mostly American) who were under the impression that it was the converse of "addendum." The dictionary seems to improve as it progresses.

* Herodotus. See Rawlinson's Translation, Book II., chap. 86.
† Mariette, *Bull. Institut egyptien*, 1869-1871, 1st Series, II., 58.
‡ Maspero, *The Dawn of Civilisation*—Egypt and Chaldea. Translated by McClure. S.P.C.K., 1910.
§ Neogi, *J. Royal Society Arts*, 1914, vol. 63, p. 43.
‖ See Hadfield, *J. Iron and Steel Inst.*, 1912, I., 134. *Survey of India* (Four Reports made during 1862-1865), Simla, 1871. St. John Vincent Day, *Proc. Phil. Society of Glasgow*, 1872, 8. No. 2, p. 235.
¶ Miss Gordon Cumming "In the Himalayas and on the Indian Plains"
** See remarks by T. Turner (*J. Iron Steel Inst.*, 1912, I. 184) and his references to earlier authorities.
†† Hadfield, addendum to paper, *loc cit.*

* Vincent A. Smith, *J. Iron Steel Inst.*, 1912, I. 158.
† For Northern India. Vincent A. Smith, *J. Iron Steel Inst.* 1912, I. 184
‡ Notably J. M. Heath in two papers on Indian Steel before the *Royal Asiatic Society*. 1837, Vol. IV.; 1837, Vol. V.

Fusion Welding.*

By S. W. Miller.

The processes of fusion welding in use at the present time depend for their sources of heat on three reactions:—(1) The burning in the presence of commercially pure oxygen of a combustible gas; acetylene is the one most frequently employed, although hydrogen, town gas, and others have been successfully used; (2) the electric current; (3) the Thermit reaction.

The first process, in its widest commercial application, makes use of acetylene and produces the highest flame temperature known, probably about 3,040 deg. C. This is by reason of its very large carbon content, 92.3 per cent.

The second process may be utilised in two principal ways:—First, by striking an arc between the piece to be welded, which is attached to one terminal of the circuit, and a rod of carbon or graphite connected with the other terminal. Second, by striking an arc between the piece to be welded and an electrode of metal, which on account of the heat of the arc is melted into the piece being welded, thus filling up the cavity or joining the pieces of metal together.

The Thermit reaction is based on the fact that aluminium has a much stronger affinity for oxygen than most of the other metals, so that if powdered aluminium is mixed with a metallic oxide, such as iron oxide, and the mass be brought to a high temperature at one point by means of a red-hot piece of iron, for example, the aluminium will combine with the oxygen of the oxide, setting free metallic iron. The reaction is propagated automatically through the mixture, with the result that aluminium oxide floats on top of the melted metal, which can be poured into a mould or otherwise utilised. In practice, the ends of the pieces to be joined are brought to a high temperature in the mould surrounding them, into which is poured the Thermit metal, which fuses into the pieces to be joined, making a solid fused joint.

The oxy-acetylene process, or as it is frequently called, gas welding, is applicable to more metals and more conditions than either of the other processes. It is limited in its application chiefly because it is difficult for practical reasons to use it on very large sections of steel, although it has been applied under suitable conditions and with suitable precautions to such large sections. Its cost is high in the case of large pieces compared with the other processes, because of the high cost of gases, but the tanks in which the gases are compressed and the rest of the apparatus are easily portable, making it very easy to take to the work. The electric-arc processes are in some respects more difficult of application because of the necessity of protecting the operator from the effect of the ultra-violet and infra-red rays of the arc. The precautions necessary in the case of acetylene welding are not so great, as the dangerous rays referred to are present in only a small degree and proper goggles are all that is necessary to protect the eyes from the glare.

For carbon arc-welding a current as high as 1,000 amperes at from 60 to 75 volts may be used, whereas a current of less than 300 amperes is of but little value. Under these conditions, some care must be taken to protect the operator against the current, and wet gloves or shoes may be more or less dangerous. With the metallic arc, a current as high as 200 amperes may be required with an arc voltage of from 18 to 20. The temperature of the positive crater of the carbon arc is about 3,480 deg. C., and the temperature is much more local than that of the oxy-acetylene flame. The carbon-arc process is usually confined to filling cavities in steel castings, although it has been used with great success in some cases for other purposes. It is not, however, as popular as the metallic arc, although the latter is confined for most practical purposes to the uniting of steel and wrought iron.

The Thermit process is of particular value for the welding of large sections of steel, and has proved of inestimable worth in the repair of such parts as stern frames and rudder frames of steamships, many notable instances of which could be cited. The temperature of the melted Thermit steel is probably about 2,760 deg. C.

Fusion-Welding Practice.

Success in the use of any process depends on several things, but a consideration of what actually occurs during welding, as far as it is known, may be of assistance in determining how far to go in using these processes. In the first place, fusion welding is simply the making of a casting of whatever metal is being welded. The conditions which will permit of sound castings being obtained in the foundry are fairly well known. The melted metal must be protected from oxidation, and care must be taken to prevent cold shuts and other defects. The metal must not be overheated and a proper alloy must be used if good castings are to be obtained. Other precautions will naturally suggest themselves to those familiar with foundry practice. In fusion welding, the conditions for the making of a good casting are largely absent. The melted metal is exposed to the air with chances of becoming oxidised or absorbing gases. It is very easy to produce laps and cold shuts; metal is easily overheated and the constituents such as carbon, zinc, tin, etc., are readily removed; also as the weld is a casting it has all the defects of a casting, even when of the best quality. It is coarse grained, has low elongation, and has comparatively little resistance to alternating stress and shock, so that when two pieces of forged metal are united by welding, it cannot be expected that the same results, either physical or chemical, may be obtained in the welded piece as existed in the forged piece. Again, any heat treatment to which the piece has been subjected is destroyed for a certain distance from the weld by the heat; and again, a metal so affected cannot be equal to that which has not been heated. In view of the above facts, it is evident that for safety and success, the maker and user of welded parts should use good judgment in the application of the processes.

Fusion Welding of Cast Iron.

The welding of cast iron is easier than that of any other metal, and the results obtained are better, except possibly in case of cast aluminium, where the results are just as good. In welding cast iron, any material that is to be added should be of such a character that the application of heat will not burn out the carbon and silicon to such an extent as to make the weld difficult to machine. This means that it should contain a considerable proportion of silicon, this being the first constituent to disappear under the heat. Ordinary machine iron is entirely unsuitable for the purpose, and it is usual for a good cast-iron welding rod to contain at least 3 per cent. of silicon. When this metal is melted into the weld, it produces a fine-grained structure lower in graphitic carbon than the material being welded, because it is applied in small quantities and cools rapidly. A properly welded piece of cast iron will always break outside the weld. The principal difficulty in cast-iron welding is in taking care of the shrinkage or contraction, which, of course, cannot be avoided, although it can usually be allowed for by expanding other parts of the piece, or by setting the pieces farther apart than they were when broken.

Chilled iron is readily welded, although, on account of its brittleness, the difficulties from expansion and contraction strains are increased when compared with grey iron. Malleable castings dare not be melted, and therefore are not capable of being welded, unless they can be annealed, which is usually impossible. It is therefore customary to join broken parts of malleable iron by using a manganese brass, or a similar alloy, which will unite with the malleable iron at a temperature below its melting point.

* Abstract of a Paper read before the American Iron and Steel Institute. The author is President of the American Welding Society, New York City.

Fusion Welding of Steel.

Fusion welding of cast steel is done in many instances as repair work in the steel foundries, and if properly done the results are entirely satisfactory. This is, of course, largely because the piece being welded is a steel casting, as is the weld. Welding of forged steel in the shape of plates, sheets, bars, and shapes is done to a very great extent, especially in manufacturing. Steel is the most difficult metal to weld, and with some varieties it is scarcely possible by any fusion process to get results that are more than moderately good. It is not common to attempt to weld steel of higher carbon content than about 0.25 per cent., and it is not wise to place any dependence on welds made in high-carbon steel. The lower the carbon content the better the results, and the welding of structural steel changes its physical characteristics so much that great care should be taken to allow for the change if any great strain comes on a piece. The difficulties in welding steel are the same as those encountered in welding other metals, but are aggravated by the high melting point, the rapid solidification, and the great change in the structure and physical properties of the metal due to the high temperature to which it is subjected during the welding process, as well as to the fact referred to before that a weld is only a casting. The best steel for welding and one which is commercially available at reasonable cost is probably of about the following composition:—Carbon, 0.15 per cent. maximum; manganese, 0.30 to 0.60; sulphur, not over 0.05; phosphorus, not over 0.04.

The ideal weld would be one in which the structure and the chemical and physical properties were identical with the piece being welded; it is evidently impossible to obtain this in any case regardless of the processes used or of the welding wire employed. We are therefore restricted to either one of two courses; we must either make the weld stronger than the piece being welded, or we must assume or find by experimenting the efficiency of the weld when it is weaker than the pieces being welded. The weakness of a weld may not, however, depend entirely on its tensile strength. This may be higher than that of the pieces being welded and still the weld may be weaker in its resistance to alternating stress or shock. These latter stresses are the ones to which welds are least resistant, so that, even if the tensile strength of a weld is equal to that of the base metal, the weld may be much weaker when stressed in any other way than by pure tension.

Stresses in welded structures are, of course, due to the heat of the welding process, and in the case of rigid material where the welded seams are long, these stresses must be largely concentrated in or near the weld. If the weld is not strong enough to resist them, it will break; if it is strong enough, the stresses will be there, as they are in cold-rolled or other cold-worked material.

The Cause of Failure.

One of the matters which is of vital interest to all those using welding processes is the cause of failures in welded parts. Generally speaking, there are two avoidable effects which are in reality one; first, lack of fusion along the side of the V, and second, the lack of fusion in the weld metal itself. The tendency in welding steel is to underheat the plate because it is much heavier in section than the welding wire, in which case the melted wire may fall into the V without being fused to it. The same thing may happen in the weld. When this occurs there is a thin film of oxide between the two layers of metal, and this, of course, destroys the strength of the piece. In addition to this there is the oxidising action of the water vapour in the gas-welding flame and that of the air on the finely divided metal passing through the electric arc. If the gas-welding flame be not properly adjusted, or if the torch be of poor design, there is the additional possibility of free oxygen being present and causing serious trouble. An improperly-made weld will show streaks of oxide or other impurities, which are frequently very small and thin, and yet the first evidence of distortion of such a weld is at these defects, just as the first evidence of distortion in a piece of steel is at similar defects. During the welding operation these defects appear as bright white spots or streaks in the case of gas-welding, which can be floated to the surface and removed. In the case of electric welding this is not possible, except to a limited extent, because whatever impurity is in the electrode must go into the weld.

It would hardly be expected that any ordinary heat treatment would alter the character of the ruptures in welds, and if defective welds were heated in an oxidising atmosphere it might be expected that they would become more brittle. Such tests as have been made indicate that this is true. On the other hand, it is found that electric welds which were very brittle as made were notably improved by heating several hours in a strongly reducing atmosphere at a temperature of about 600 deg. C. This would indicate that the difficulty is one of oxide.

Prevention of Oxidation.

Oxidation should evidently be less severe in the case of gas welds than in electric welds. First, because the temperature is not so high, and second, because of the protecting influence of the envelope flame, which is composed of hydrogen and CO burning to water and CO_2. In the electric arc the temperature is very high, and the metal passing over the electrode to the weld is very finely divided, with naturally great oxidation. It will appear clear that if the melted metal could be covered with a protecting slag, oxidation would be much lessened. This has been done for a number of years in electric welding by coating the electrodes with compositions of various kinds which produce slags of various viscosities. If the slag is too viscous it may be entangled in the weld, weakening it, and if too thin it will not protect the metal; but it is a fact that electrodes of this type when properly used give a sounder weld than electrodes made of bare wire. With gas welding no organised attempt has been made to provide such a slag covering. It is rather curious that nickel-steel welding-rod seems to provide a very thin slag and produces a weld which is much less oxidised than one made of ordinary low-carbon steel. This seems to be due to the formation of nickel oxide. It is noticeable that the scale on a nickel-steel weld adheres much more strongly than that on one made of ordinary wire.

While a coated wire doubtless makes a better weld than a bare one, its use is attended by difficulties such as the inclusion of the coating in the weld, and its expense, so that unless the weld must be of superior quality its use is not desirable.

Effect of Welding Heat on Base Metal.

All welding operations affect the base metal, as does any other method of applying heat, but as the heat is more local, the distance from the weld that is so affected is less than in forge welding. As a consequence, the changes in structure may be compressed into a very short space. In any form of welding the heat must be supplied at a greater rate than it is removed from the base metal by radiation and conduction, and in fusion welding it is supplied very rapidly. In the case of electric arc-welding of a ⅜-in. plate the entire range of change in structure may be found within about 1/16-in. of the line of the V, while in gas-welding plates of the same thickness they will occupy about 1½-in. from the line of the V.

It would naturally be inquired whether heat treatment would not remove the effects of the heating due to the welding, and it may be said that this is quite possible, but in most cases too costly; therefore, unless in special instances the designer of welded parts should not consider the possibilities of heat treatment, but make his designs to suit welds as they are made.

Effect of Nitrogen on the Weld.

There has been much discussion as to the effect of nitrogen on steel, some taking the position that it makes steel brittle and others that it has very little, if any, effect. It seems that in view of all the facts the brittleness of welds is due to the presence of oxides, and that in the future we will be able to make much better welds by providing some effective but simple means for the protection of the melted metal from the air, or for removing from the weld the oxides as they are formed.

Electric Capstans.

Most people are familiar with the application of electric capstans in dockyards and railway sidings, where one cannot help being impressed with the neatness and simplicity of this method of hauling, but in foundries their application is somewhat novel.

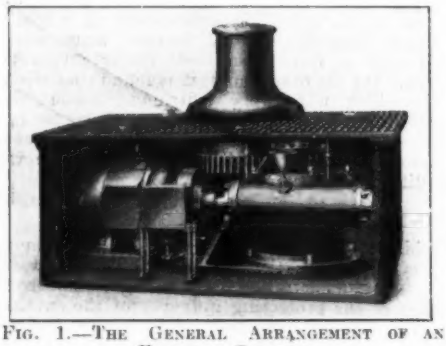


FIG. 1.—THE GENERAL ARRANGEMENT OF AN ELECTRIC CAPSTAN.

Methods of withdrawing a truck load of castings from an annealing oven and moulds from a drying stove vary from a combined effort by the greater portion of the foundry staff to an anchored pulley block, around which a chain is passed, one end being attached to the carriage and the other to the overhead crane-hook. The latter method can be satisfactory providing a straight lift is communicated to the crane, but quite often it so happens that such conditions do not obtain, and the crane is subjected to stress of a kind which it was never designed to withstand. Realising that crude conditions obtain in most foundries, Messrs. Thomas Broadbent & Sons, Limited, of Huddersfield and Suffolk House, Laurence Pountney Hill, E.C.4, have placed upon the market an electric capstan which has special applications to foundry practice. The arrangement of the machine is shown in Fig. 1, and its application to the withdrawing of trucks from core-drying stoves in Fig. 2.

The outstanding features of the plant are waterproof outer cases, on which provision is made for condensation; the accessibility of working parts, and a locking device for preventing its use by unauthorised persons.

The use of capstans in the foundry is by no means limited to the manœuvring of carriages in and out of the various furnaces, but they can usefully be employed for hauling truck loads of castings from the fettling shops into the stockyards and for hauling heavy castings about the stockyards. A capstan installed in a foundry with a number of judiciously arranged fairleads can be utilised for many purposes, and it is surprising that they are not used to greater extent.

The Blending of Foundry Metals.

In the course of an interesting lecture dealing with the selection of engineering metals recently given before the Stoke-on-Trent Association of Engineers, Mr. Arnold Green, lecturer in metallurgy at the Central School of Science and Technology, Stoke, dealt incidentally with some of the points which it is necessary to watch in the production of cast iron in ordinary foundry practice. He pointed out that although cast iron is not a pure metal, such as steel, which consists practically of iron and carbon with a very small percentage of impurities, but a heterogeneous mixture consisting of 92 or 93 per cent. of iron and the remainder impurities or other metalloids, such as silicon, manganese and phosphorus, along with sulphur and carbon, it is highly important that the product should possess certain clearly-defined properties. Although cast iron is not expected to display the high tensile strength of steel, it should at least possess a greater compressive strength.

Very crudely expressed, the idea of foundry practice was to obtain a material that would take the mould and that possessed such properties as were commonly expected of a cast iron. In the earlier days it was the practice to brand irons by the localities in which they were produced. It was customary to speak of a Cleveland iron, or of a Northampton iron, or of a Staffordshire iron, and so on. This came about in consequence of a recognition of certain specific properties exhibited by the materials which issued from the respective districts. Later research, however—mainly the work of Prof. Turner, of Birmingham, and Dr. Hatfield, of Sheffield—had shown that the iron of various localities contained varying percentages of metalloids. A Northampton pig-iron, for instance, contained a good deal of phosphorus, a Cleveland pig-iron, a high silicon content, a North Staffordshire iron much manganese, and so on. Foundry practice, roughly expressed, amounted to the adequate mixing of these various types of pig-iron—in other words, the blending of the respective good qualities of the Cleveland, Northampton and Staffordshire pig-irons, with an endeavour to include the undesirable qualities of none of them. This would be a fine ideal if it could be put into effect, but, unfortunately, as a rule, very few rigorous tests were carried out in the foundry. If, with each fresh batch of pig-iron that was received, some reliable idea could be obtained of the chemical constitution of the material, the foundry manager would be in a position to state, with a fair degree of accuracy, the amount of Northampton iron that should be mixed with a Staffordshire or a Cleveland iron to give the best practical results.

The essential property of pig-iron for general foundry work was its capacity to take an impression of the mould. Keep (an American research chemist) had suggested a schedule of properties that would reliably indicate the value of a metal

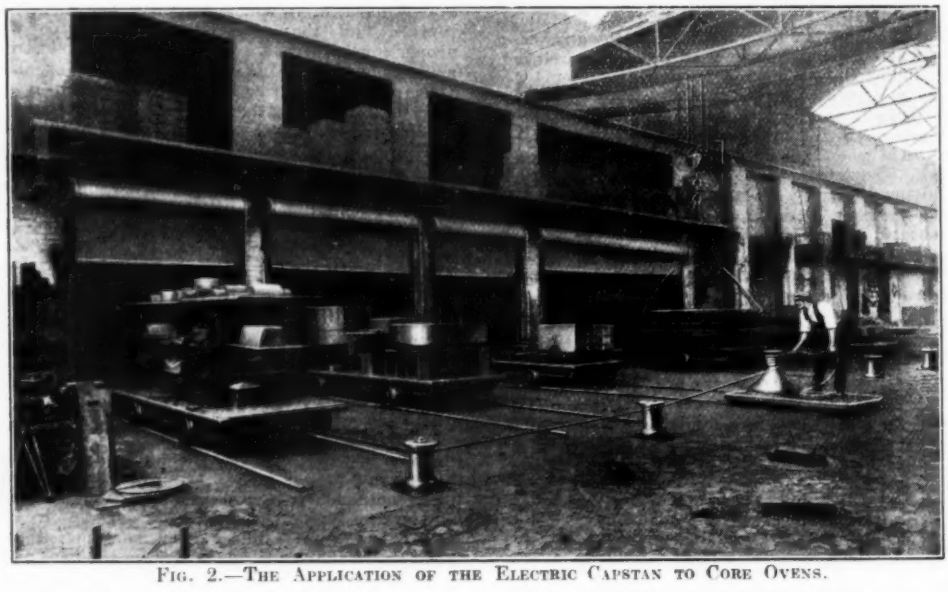


FIG. 2.—THE APPLICATION OF THE ELECTRIC CAPSTAN TO CORE OVENS.

for foundry work. These tests had provided criteria which should help the average foundryman very considerably, but, unfortunately, there were not the facilities on the ordinary run of foundries to carry out the tests necessary to determine these qualifying properties. One was disposed to believe that the production of so many bad castings would be very largely obviated if such tests could be arranged for.

The disposition of carbon in a foundry iron was very interesting from a theoretical point of view. So far as steel was concerned, carbon was generally accepted as being present in the combined or carbide form. The carbon in pig-iron was not present in that form at all; it was present in two, or possibly three, different formations. It might be present, firstly, as flakes of graphite, secondly as iron carbide, or, thirdly, as very finely-divided portions of graphite. The presence of a certain percentage of silicon, *i.e.*, 2.2 to 2.8 per cent., disposed the carbon to take on the graphitic form, and the very fact that carbon was prevailed upon to take the graphitic form rendered foundry practice possible. It resulted in a very much more ductile and workable metal, for it disposed of some of those brittle properties which would otherwise be present in cast iron, and which, for many types of work, would render the metal inefficacious. The first criterion, then, of a cast iron for foundry work was the amount of silicon present.

Manganese disposed the sulphur to take on a combination with itself. Whereas iron sulphide, of itself, gave rise to a whole host of deleterious characteristics, if it were possible to get the sulphur into the form of manganese sulphide, many of these undesirable qualities could be eliminated. Manganese, therefore, was necessary to some degree in a pig-iron, because sulphur was always more or less present. Manganese was particularly present in North Staffordshire ores, and they were sought after on this account.

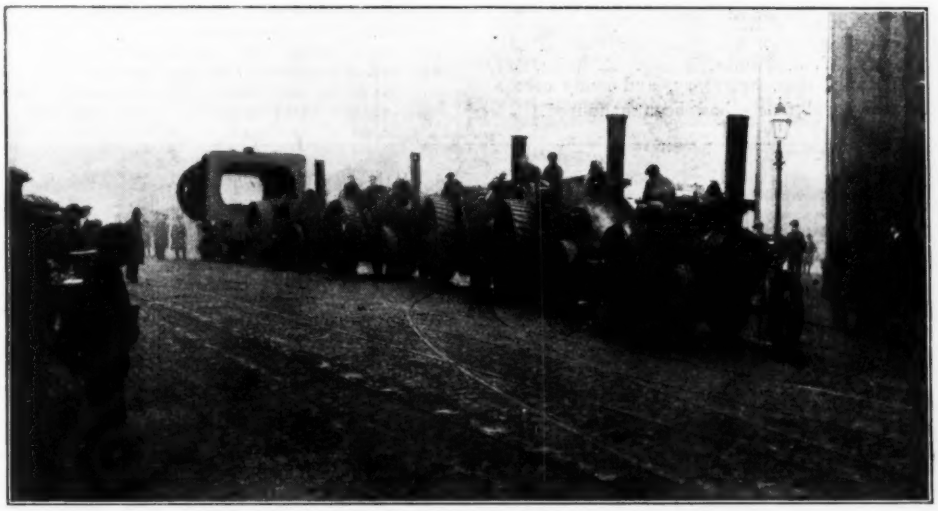
The Northampton irons contained a good deal of phosphorus, which, if allowed to exert itself uncontrolled, was a very deleterious element. If, therefore, a phosphoric pig-iron could be scientifically mixed with a manganese iron, and with a hematite containing a good deal of silicon and very little of manganese or sulphur, it would be possible to keep down the phosphorus and obtain, as a consequence, a better fluidity in the metal. It was simply a case of intelligently blending one pig-iron with another and noting the results.

The value of physical metallurgy was, as yet, insufficiently appreciated. A real conception of the ultimate nature of metal crystallisation would tend to eliminate half the faults that were commonly met with in foundry practice and engineering alike.

The Royal Agricultural Society of England will this year hold their show at Cambridge from July 4 to July 8.

The Largest Ingot Mould Ever Cast in Great Britain.

The ingot mould which we illustrate below is the largest ever made in this country. The weight is approximately 110 tons, the inside dimensions are 108 in. × 68 in. × 148 ft. long, and the thickness of metal varies from 15 to 18 in. in the body to 24 in. in the belts. This mould was built in a 16-ft. pit, and the centre core lowered in. For casting it took one 45-ton ladle, one 23-ton, two 17-ton, one 8- and one 7-ton ladles. The melting time took about four hours, and it was poured in 4¾ minutes. The casting fed for six hours, and took three weeks to cool. It had to be delivered by road; no difficulty was experienced. The 150-ton crane at the Newhall Road Works of the Brightside Foundry & Engineering Company, Limited, where it was made, picked the casting up and deposited it on the truck. Messrs. Coupe Brothers coupled up their traction engines, and the whole was on its way in twenty minutes.



THE LARGEST INGOT MOULD EVER CAST IN GREAT BRITAIN.

A New Process for the Estimation of Oxygen in Iron.*

The authors discuss the influence of time and temperature upon the quantity of oxygen reducible by hydrogen in the tests of basic steel before and after the process of deoxidation. From the results of experiments they have devised a process whereby a more satisfactory determination of the oxygen may be effected, consisting of a liquefaction of the test sample by the addition of substances (tin and antimony), which lower the melting-point. With a reducing temperature of 950 deg. C. made possible by this means, and a period of 120 min., practically all the oxygen in the manganese, in a mixture of ferrous and manganous oxides, was made reducible, while, with a reducing temperature of 1,150 deg C., only a small portion of the oxygen in the manganese compound could be taken account of. By the new method, iron and manganese oxides, mixed in any proportion, could be wholly reduced. In the case of iron and silicon oxides in which the silicic acid content does not exceed 20 per cent., at least 93 per cent. of the total oxygen content may be reduced. The question is discussed in detail, with numerous diagrammatic illustrations. In these experiments it was found that the melting-point of pure ferrous oxide was 1,390 deg. C., that of a mixture of ferrous oxide with 25 per cent. of manganous oxide 1,470 deg. C., and that of ferrous oxide with 50 per cent. of manganous oxide 1,513 deg. C. The first was wholly reduced at 950 deg. C. in 20 min. For the other mixtures, the time required was 100 min.—P. OBERHOFFER and O. VON KEIL (*St. und Eis*, 41, 1449-1453.)

* Institution of Civil Engineers Abstract.

Institution of British Foundrymen.

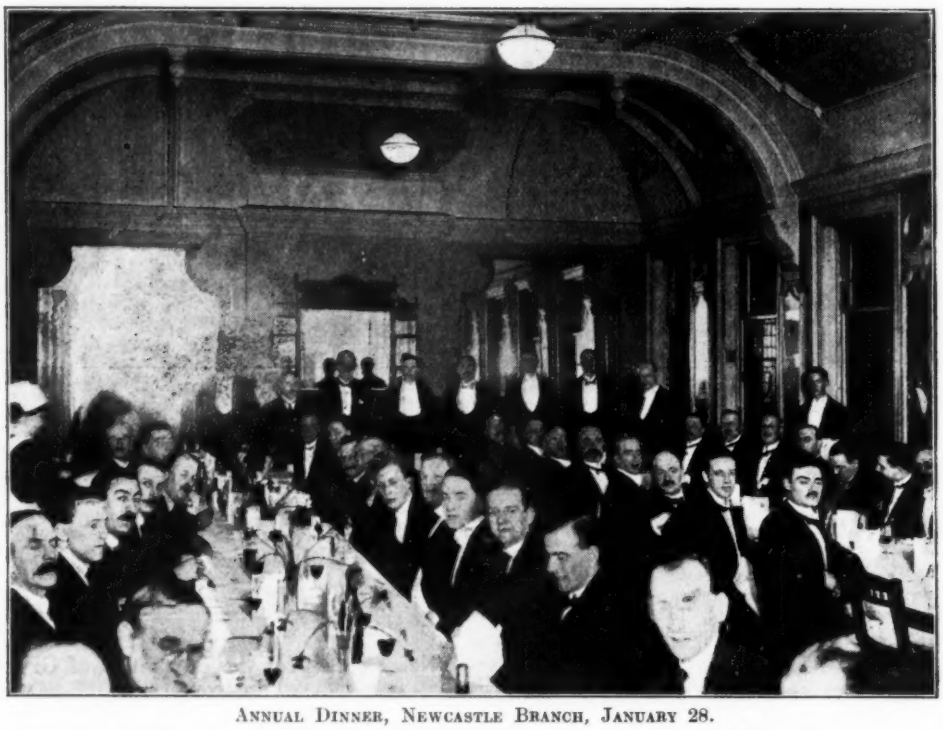
NEWCASTLE BRANCH.

The annual dinner took place on January 28 at the County Hotel.

The chair was occupied by the Branch-President, Mr. R. O. Patterson, and there were also present the President of the Institution, Mr. Oliver Stubbs, the Deputy Lord Mayor of Newcastle (Councillor Capt. Arthur Lambert, M.C.), Sir Archibald Ross, K.B.E., Professor H. Louis, Professor Engineer-Commander Hawkes, R.N. (ret.), representing Armstrong College; Councillor Edward Smith, Mayor of South Shields, Mr. H. J. Young, F.I.C., Mr. J. D. Carmichael, Mr. V. C. Faulkner, Mr. Matthew Gallon, Mr. Ireland, Mr. W. J. Paulin, Mr. S. W. Wise, Mr. H. A. J. Rang, Hon. Secretary, and many others.

After the loyal toasts had been honoured,

It was a fact that iron-founding work was far too little known amongst the average men in the street. The industry of iron founding had always struck him as being the Cinderella of industry, and he need not tell them that the native modesty of iron-founders might have something to do with that. On the other hand, it was undoubted that their work was overshadowed. The work of the iron-founder was wedged in between the work of the ironmaster on one side and the work of the engineer on the other. He took the finished product of the one and converted it into the raw material of the other, and being squeezed in between those two great industries the average man overlooked the ironfounder's work and existence altogether; and the ignorance of people at large as to how their work was carried on was really rather surprising.



Annual Dinner, Newcastle Branch, January 28.

Councillor Edward Smith, of South Shields, proposed "Our Guests" in a happy speech, in which he extolled social gatherings as one of the best means solving foundry difficulties.

Prices and Wages.

Councillor Capt. Arthur Lambert, M.C., replied that he understood their Association was particularly interested in encouraging co-operation between all who were engaged in their industry, whether they were employers or employees, and on that account he was quite sure the Corporation of Newcastle was quite ready and willing to encourage such an Association to the best of its ability. If they could only get back the spirit of comradeship and spirit of help and co-operation which they had in France during the war, and always be ready to forward the cause they had at heart, that would help them through the difficult times through which they were passing.

Science in the Foundry.

Professor Louis, Armstrong College, also replied to the toast, pointing out that their guests that night represented many different interests, and the fact that they had selected a representative of the Corporation of Newcastle and a member of the local University College to reply to that toast might be taken to signify that they felt definitely the need of their industry having closer points of contact with the citizens at large on the one hand and of the higher educational body on the other. Might he say that he thought they had shown their very great wisdom in both those selections.

The True Craftsman.

The immense importance of founding had become very largely overlooked. It was for that reason that they had had for some time past great difficulty in getting apprentices to go into the foundry industry. Men did not take to it; they preferred to go into one of the better-known industries. Another reason was that the apprenticeship to the iron moulding was, after all, a long and arduous drudgery, and it necessarily must be so, because the moulder was, perhaps, of all workmen the best representative they had left of the true craftsman, and the really skilled member came nearer to being an artist than any other craftsman. The man who could repair damage so skilfully that they could not see where the flaw had been came very near to the skill of the sculptor in his work. It was manual dexterity of a high grade, and it required a hard and irksome apprenticeship. Moulders' work was carried on in foundries which were perhaps a good deal more dirty and dingy than there was any need for them to be, and he might suggest in that respect, at any rate, that much needed reform was long overdue.

Science and Art.

The connection between the iron foundry and the University had rather more points of contact than most industries, because it was two-fold—scientific and artistic. A college which trained artists and tradesmen, trained men in the co-ordination of hand and eye work, and trained men with a true appreciation of art, was really helping the iron-founding industry in a very great

measure. The man who had had his artistic perception developed was far more likely to be useful in turning out a graceful and well-proportioned casting, and seeing by his trained eye where he could save material and where that would add immensely to the appearance of an article.

There was no doubt that we in this country fell below both America and the Continental foundries in that respect; we could not teach them anything in the artistic quality of the work we turned out. From the artistic point of view, the fact of having a college in their midst was one of the ways in which that difficulty might be overcome.

He need say very little as regards the scientific side of the subject. They at the College appreciated that a knowledge of pure science by itself was of very little use until they learned how to apply it; and it could only be by close co-operation between those who were studying science and foundrymen who had to apply it that real progress could be made. The iron-founding industry was using science more and more. When it was ascertained that a certain brand of iron was better than another for castings, and the chemist could not tell them why, it was only because chemical science had not been carried far enough. They had been trying to find out the effect of the more important elements upon a casting, and the time was coming when they would have to consider the effect of the minute proportions of the rarer elements. When they talked of securing a better skin on their castings, that meant they had some of those forces at work which they were only beginning to find out, and what the meaning of infinitesimal traces of substances could be in that respect. Science was making greater and greater strides every day, and its application to industry must go forward more and more rapidly.

He was pleased to know that a research association for the foundry trade had been established, and he thought in that way some of those recondite secrets of nature would be found out. The application of those was not purely academic, for the man who could apply his science properly in the foundry would show that in the most important place of all—the balance sheet; and it was by the work of an association like theirs, and their research association, that that important result would be attained.

MR. W. J. PAULIN, in proposing "The Industries of the North-East Coast," said they had passed through a pretty bad time lately, and few of them were looking forward very cheerfully to the next twelve months. He hoped that the reply would point out what the prospects for the immediate future were.

Trade Prospects.

SIR ARCHIBALD ROSS, who responded, said there were no immediate prospects of any "pick up." There was really only one thing that would keep this country going. They could not attempt to compete with people who sold things at a price which we could not touch at the present cost of material, let alone establishment charges. No concern could go on indefinitely like that, although they might do so for a certain period. Where we would score in the future, as we had scored in the past, was in our reputation, which at one time was a monopoly, but not now in so far as knowing how to make things was concerned. British work had always stood first and would always stand first. The Institution of British Foundrymen helped to procure the high quality goods.

Proceeding, Sir Archibald pleaded for the necessity for research, increased output, and cheapened production. Two things seemed to go on whatever happened. He did not wish the one any harm, but he would like to see the other done away with. One was the "pictures" and the other the doles. The former in moderation could be educational and prove a relief from the tedium of life; the latter were a very mixed blessing.

It is only by production and excellence of work that we shall get our custom back again and so decrease the amount of people who are living on doles, which are not encouraging them to return to work when they might. The whole question of the present condition of affairs is the result of the war. After every big war there has been this sort of upheaval, on a smaller or greater scale, and as this was the biggest war this has been the greatest upheaval.

A Growing Success.

MR. H. J. YOUNG proposed "Our Institution," and said they would all agree that their Institution was a success, and not only a success, but a growing success. Most institutions seemed to have reached a certain height and then to go no higher. He thought the Institution of British Foundrymen was going very much higher; in fact, he knew of no association which was increasing its membership and its power so much as they had done during the past few years. They had not only employees, but they had employers in their ranks. Up to now they had hid their light under a bushel. Every member ought to try and do his best for the Institution, to make a success of their meetings and their research work. In their daily work they met with many problems, and they ought to bring them forward at their meetings.

The Royal Charter.

Nobody had mentioned that they were an Institution, with a Royal Charter. Some people seemed to think that a Royal Charter did not matter; but everything did matter in this world. It meant that they had something to live up to, and it did not mean anything else, and it was their duty to live up to it and do better work. Their work was being starved as far as money and science were concerned, and it was up to every foundryman to try and raise his profession and art so that employers and the general public would recognise it and appreciate that it was a little more than they had hitherto thought it.

Speech by the President.

MR. OLIVER STUBBS, President of the Institution, remarked at the outset that the Institution was entirely what the branches made it. The head office was merely the clearing house. It had always been one of his objects in life to take up any work that would bring a better understanding among those of them who were engaged in the industry than what already existed, and he was a firm believer in meeting together for discussion and for business; and he was also a firm believer in the social board. They did not get amongst each other sufficiently; there was too much suspicion, and they would find that if they imagined someone had something up against them when they inquired into it they would find that nothing of the sort existed. They should begin to understand the ground along which humanity moved. He believed that Institution was doing far more to remove those differences of opinion which had existed far too long in the foundry industry, than anything else. It was his opinion that the average moulder, core-maker, and other workers in the foundry were as good as they would get anywhere, if they would only treat them properly and lead them in the right way. It was only by making everybody feel that they were units that they were going to make a success of a business. The boy or the top man was equally important, and they would not have any difficulty in getting apprentices if they would make their foundries more attractive, and take more trouble with their boys when they were in the foundry.

Out-of-Date Text Books.

He was pleased to tell them that at Sheffield they had just commenced an iron-foundry class, and it was going to be run by practical people in the iron-foundry industry. He hoped the Professor would forgive him for making those remarks, but it was no use talking science to the average moulder. They could make the lower positions better by giving them information in such language as they would understand and would be useful to them. Their education should be brought up to date and they should scrap their present text-books, which were out of date.

He was pleased to tell them that the membership was increasing, which was particularly gratifying at the present time, when they remembered how much unemployment there existed, which made it hard for many members to pay their subscriptions. Now they had a total of twenty-one subscribing firms, but he did not consider that was anything like enough. If he had any regret in connection with his year of office it was that he would have to retire according to rule in June next, just when he was getting a grip of things.

They had over three thousand foundries in the country, and the membership worked out at a little over half a member per foundry in his country, which was insufficient. As regards subscribing firms, they ought to have a couple of hundred or more, and he believed they could get them.

A Newcastle Convention.

He appreciated all the President, Mr. Patterson had done, and concluded by remarking that it was time they had a convention in Newcastle. it was their own fault they did not get one, for they got nothing in this world without asking for it. And it would be their own fault if they were not successful in securing a convention for Newcastle.

On the motion of Mr. James Smith, the toast of "Our President" was enthusiastically honoured, and Mr. Patterson made a suitable response.

A delightful programme of music was provided by the Gateshead Quartette Party—Messrs. George Deacon, J. H. Armstrong, Fred McNaughton, and John Burke—and Mr. Ted Cryer (humorist), with Mr. Charles Burcham as accompanist.

NOTES FROM THE BRANCHES.

Newcastle.

Mr. M. E. Gallon, past Branch-President, has retired from active business, and has left Tyneside for Liss, in Hampshire. The loss of his genial personality will be much regretted in the Branch. We wish him good health and long life to enjoy his well-earned rest from business.

Mr. E. J. Rang, Associate, is to be congratulated on the successful reading and discussion of his Paper on "The Training of an Engineer" before the Institute of Civil Engineers in Newcastle-on-Tyne recently.

Mr. S. W. Wise, Junior Vice-President, has taken over the active management of Messrs. Younger & Gallon's Foundry, Dunston, in which he is now a partner.

The annual dinner of the Newcastle and District Branch recently held was quite a success. Guests were present from London, Birmingham and elsewhere. Under the genial chairmanship of Mr. R. O. Patterson, a most enjoyable evening was spent by all present.

Mr. H. J. Young, F.I.C., has been added to the Committee on Test Bars.

London.

A visit was paid to the works of the Ealing Park Foundry last Saturday. About 50 members and friends availed themselves of the opportunity afforded to visit a modern foundry within a few miles of the West-end of Town.

Mr. Wesley Lambert, M.I.C.E., has been added to the Committee on Test-bars.

Mr. T. D. Robertson, junior Vice-President, has resigned from the Branch, as he is shortly leaving for Australia to take up a position with Messrs. Hadfields (Australia), Limited, of Sydney. Col. W. F. Cheeswright, D.S.O., has been elected to fill the vacancy thus created.

Mr. Robert J. Shaw, of the Ealing Park Foundry, has been elected to the Council.

Foundry Queries.

22d. We are having trouble with our piston-ring castings, the fault being the rings are spongey and break on compressure. We use either a mixture of equal parts of Thorncliffe No. 3 and good scrap, or one of Frodair and good scrap, but neither has been satisfactory. We cast our bushes with a flange at the top, running the metal in at the top, and have also tried running the metal in at the bottom, but, again, neither has been successful. The rings are for steam engines, and vary from 6 in. to 14 in. dia.—ENQUIRER.

MR. JOSEPH BRADSHAW LEES, whose death is announced, was a nephew of Mr. George Bradshaw, the governing director of Geo. Bradshaw & Company, Limited, metal merchants, 64, Cross Street, Manchester. He joined the firm in September, 1889, as a junior clerk, and when the business was made into a limited company he became a director.

The British Cast-Iron Research Association.

The first ordinary general meeting of the British Cast-Iron Research Association was held at Manchester on February 16, the Chairman of the Council, Mr. H. B. Weeks (Vickers, Limited) presiding.

On the motion of the CHAIRMAN, seconded by Mr. G. PATE (Carron Company), the election of Lord Weir, of Eastwood, as President, and of the Vice-Presidents, was confirmed, their term of office to date from the present meeting.

The CHAIRMAN, in a review of the activities of the Association, said there were now 166 members, but as there were 3,000 foundries in Great Britain, there was room for improvement. The six committees had held 57 meetings during the past nine months. An acting Director of Research had been appointed, and a staff was constantly abstracting matters of interest to the industry from all journals, practically throughout the world. The members had submitted something like 68 problems for elucidation; many were such as arose in the ordinary routine of foundry practice, but there were nine subjects which the Council considered suitable for fundamental research, and it would be carried out as opportunity offered. The research into motor-car internal-combustion engine cylinder castings were being carried out jointly with the Motor Manufacturers' Research Association.

A subject of very great interest was the standardisation of a method of testing cast-iron.

The bureau and library of the Association had been found of great use. Meetings of a propaganda nature had been held in various industrial centres. Every foundry in the country had been circularised, and nothing was left undone to impress upon those engaged in the foundry industry the importance of this movement for raising it to a higher level. The Institution of British Foundrymen were the pioneers in this work. but the two organisations did not overlap. In his view the Research Association began where the Institution left off. The objects of the latter were the consideration in common of the difficulties and trouble which constantly arose in foundry practice, but the Research Association contemplated the investigation of wider and deeper scientific problems which could not be easily solved in the ordinary foundry, and called for systematic research.

The CHAIRMAN, replying to Mr. G. Pate (Carron Company), as to whether they had got laboratories fully equipped and qualified to tackle these problems, said that at the present moment the Association had no laboratories of its own, but there were laboratories in the country—for instance, the National Physical Laboratory, at Teddington—who were anxious to help in every possible way, and quite a lot of analytical work had been done for the Association. What the Council had in mind was that wherever possible research should be carried out where a problem arose, the Association, of course, defraying the cost. They would be very glad to have a laboratory of their own, but at present the funds did not allow of one being established.

MR. PATE said he wanted to impress upon the Council the desirability of having a laboratory established, with an efficient and qualified staff capable of investigating thoroughly the major problems which baffled ironfounders who already had laboratories at their works.

MR. O. STUBBS (Messrs. J. Stubbs, Limited) pointed out that the work of the Association was limited by the amount of support it received, and at the moment it was affected by the slump in trade, but when things mended they would be able to spend more money in the direction indicated by Mr. Pate; British ironfounders ought not to be in the position of relying upon America for the progress of technical knowledge in the foundry industry. Unless it advanced it would retreat.

Italian Iron and Steel Output.—The Italian production of pig-iron for 1921 shows a falling off from that of 1920, by as much as 45 per cent., which may be compared with one of 70 per cent. over in 1920, the 1913 figures. The recent decline has been the result of the general crisis through which the iron and steel industry of Italy has passed of late, while the previous reduction in output was due, mainly to the lack of raw materials and labour difficulties. Steel ingots and castings have lately made a small gain, but production on the whole is disappointing. The complete figures for 1921 are promised shortly by the Minister of Commerce, who intimates that the result for the past year in both pig-iron and steel output will prove disappointing. In most of the Italian trades and industries, the labour situation continues to be a serious problem. At the end of last year the number of unemployed exceeded 495,000, as compared with 460,000 in September.

Trade Talk.

SERIOUS damage has been caused by fire at the works of W. Bradley, engineer, Gooder Lane, Rastrick, Brighouse.

THOS. W. WARD, LIMITED, are negotiating to take over from the Admiralty the naval depôt at Inverkeithing.

FULL-TIME EMPLOYMENT has been resumed at the engineering works of G. & J. Weir, Limited, Cathcart, Glasgow.

THE HANYANG IRON WORKS, in view of the great decrease of Chinese iron exports last year, has discharged about 2,000 labourers.

A LARGE number of men will be affected by the closing of the Elswick works of Sir W. G. Armstrong, Whitworth & Company, Limited.

THE ENGLISH CROWN SPELTER WORKS at Port Tennant, Swansea, have re-started after a period of idleness extending over two years.

MESSRS. JAMES LYON & COMPANY, iron, steel and nail merchants, Liverpool, have removed from 68/70, Old Hall Street to 90/96, Cranmer Street.

MR. G. W. MOTTRAM, machinery, etc., merchant, has removed from 161, New Bond Street, W., to 1, Montague Street, Russell Square, W.C.1.

WILKES, LTD., Grand Junction Works, Darlaston, have appointed John Cawley & Company, 53, Victoria Street, Westminster, S.W.1, as their London agents.

SIEMENS, BROS. & COMPANY, LIMITED, have been successful in securing against keen competition an order for an automatic telephone exchange for 6,000 lines in Winnipeg, Canada

THE EMPLOYES of Messrs. James Howden & Company, Limited, engineers, Glasgow, have contributed the sum of £533 for the year 1921 on behalf of various local charitable institutions.

THE MIDLAND COAL, COKE AND IRON COMPANY, LIMITED, North Staffs., have lit another blast furnace, and ironstone mines which have been closed for twelve months have been re-opened.

JOHN RUSSELL & COMPANY, LIMITED, Alma Tube Works, Walsall, have recently opened a depot for the sale of tubes and fittings of all descriptions at the Belmont Works, New Spring Street, Birmingham.

THE SWANSEA UNIVERSITY COLLEGE has received a cheque for £850 from the Welsh Engineers and Founders' Association, being a first instalment towards the cost of staffing and equipping a Department of Engineering.

THE ANNUAL MEETING of the Association of Technical Institutions will take place at the Leathersellers' Hall, St. Helen's Place, E.C., on Friday and Saturday, March 3 and 4. The president-elect is Mr. Walter Runciman.

THOMAS L. HALE, LIMITED, Dudley Port, Tipton, Staffs, have appointed Mr. N. Mitchell, 28, Flanders Road, Bedford Park, London, W.4, as their London agent, Mr. W. Clarkson having been elected a director of the company.

THE Central Ironmoulders' Association have received intimation of the intention of a Falkirk ironfounding firm to adopt a system of short time working, whereby their employés will be given only five days work out of twelve.

THE HELICAL BAR & ENGINEERING COMPANY, 72-74, Victoria Street, London, S.W.1, have recently been appointed sole selling agents in this country for Le Materiel Roulant, Constructions, Forges et Fonderies de Fourchambault, of Paris.

THE ANNUAL MEETING of the South Wales Branch of the Institution of Mechanical Engineers was held at Cardiff on February 9. Mr. D. E. Roberts (vice-chairman) presided. The annual dinner followed, at which Mr. Roberts again presided.

THE GREENWICH COMMERCIAL INSTITUTE, Blackheath Road, S.E.10, announce that a series of five lectures on the iron and steel trades are to be given by Mr. H. J. Skelton. The lectures will be given on Thursdays at 7.30 p.m., starting with March 9.

THE CONSOLIDATED BRAKE AND ENGINEERING COMPANY, LIMITED, Nevill, Druce & Company, Limited, Hay, Maryon & Company, Limited, Dick & Parker, Limited, and Thompson Bros. (Bilston), Limited, have joined the Federation of British Industries.

THE HULL CORPORATION TRAMWAYS COMMITTEE have accepted the tender of Walter Scott, Limited, Leeds, for 1,000 tons of steel rails at £12 per ton, plus 12s. 6d. for special treatment. The lowest German tender was £11 15s., with £1 per ton for special treatment.

SCOTTISH CONTRACTORS have been notified that their tenders for iron work for the New York-New Jersey vehicular tunnel have been banned by the Inter-State Commission in charge of its construction, which has decided that only United States tenders are to be considered and only American manufactured iron used. The feeling of soreness created by this decision is increased because the Glasgow Corporation recently placed large orders in America for tramway rails.

MESSRS. DARBY & COMPANY, Guildhall Buildings, Navigation Street, Birmingham, have been appointed selling agents to John Lysaght, Limited, Scunthorpe, for the sale of their foundry, forge, and basic pig-iron, steel billets and sheet bars for the districts south of Yorkshire and Lancashire.

MR. F. C. A. H. LANTSBERRY, of Sheffield, recently gave a lecture at the Sheffield University on "The Mechanical Properties of Metals" to a joint meeting of the local branches of the Society of Engineers and Metallurgists, the Institution of Metals, and the Institution of British Foundrymen.

THE HUA HSIN WEAVING MACHINE COMPANY at North Shansi Road, Shanghai, was organised by Tsai Hung-pin, Kou Hui Ming, Kou Fu-chen, and others. The company has now more than over 100 labourers, and manufactures iron satin weaving machines, wooden machines and cotton gins.

MESSRS. LITHGOWS, LIMITED, shipbuilders, Port-Glasgow, have, it is reported, received from Australian owners an order for the construction of a steamer about 280 feet in length, to steam about 16 knots. The vessel is to have extensive passenger accommodation, and is to be delivered before the end of the year.

THE MEMBERS of the Institution of British Foundrymen (Newcastle and District Branch) met on last Saturday at the Neville Hall, Newcastle-on-Tyne, when a lecture was given by Mr. F. Darley, foundry manager of Thos. Firth & Sons, Ltd., Sheffield, on "The Production of Steel Castings."

THE BRISTOL AND SOUTH WALES SECTION of the Society of Chemical Industry held a meeting at the University recently. Dr. T. Howard Butler occupied the chair, Mr. C. J. Waterfall, chairman of the Section, being indisposed. Professor S. H. Reynolds, of Bristol University, read a paper on "Some Local Aspects of Industrial Geology."

ON FEBRUARY 18 there was a joint meeting in Sheffield of the Derby and Sheffield branches of the Institution of British Foundrymen, the members in the afternoon visiting the Brown Firth research laboratory at Attercliffe. In the Cutlers' Hall, in the evening, Mr. A. Poole, of Stoke-on-Trent, read a paper on "Cupola Facts, Factors and Fancies."

THE FINAL TRANSFER of the staff of Nobel Industries, Limited, to Nobel House, Buckingham Gate, S.W.1, has now been completed. The head office at 6, Cavendish Square, W.1, has been closed. For some months past workmen have been engaged in reconstructing the Buckingham Palace Hotel to make it suitable for the offices of this concern, and the work is now nearing completion.

LICENCES UNDER THE Non-Ferrous Metal Industry Act, 1918, have been granted to W. A. Endersby, 15, Hitchen Road, Luton; E. Faint, trading as William Faint & Son, 86, Store Street, Ancoats, Manchester; A. Hulton & Son, 85, Hornby Street, Bury; W. H. Protheroe & Company, 5, Great Western Crescent, Llanelly; and E. C. Thomson, trading as George Blair, 11, Queen Street, Glasgow.

AT the Anglo-German Arbitration Tribunal in London last week, the case was mentioned of the Zinc Corporation, Ltd., against Aron Hersch & Sons, carrying on business in London and Australia in respect of a dispute about the value of spelter. It was announced the matter had been settled by respondents agreeing to pay to the claimants £25,000 in settlement, each party to pay its own costs.

THE COUNCIL of the Birmingham Chamber of Commerce has arranged to promote an Industrial and Commercial Efficiency Exhibition on larger and more comprehensive lines than the eminently successful business exhibition held in the autumn of 1920. The exhibition will be held at the Bingley Hall, Birmingham, from May 25 to June 3, inclusive, with Mr. G. Henry Wright as secretary, and Mr. Charles Stanley as general manager.

THE YORK WAGON WORKS of the North-Eastern Railway has just turned out a new 70-ton bogie trolley wagon to meet the requirements of conveyance of electrical plant from the Tyne. The wagon is mounted on two six-wheeled bogies, with plate-side frames. The vehicle will carry a load up to 70 tons either concentrated in the centre, or distributed over the well, and is fitted with transverse and longitudinal beams for securing the load. The wagon will shortly convey its first load, an electrical stator, from C. A. Parsons & Company, Limited, Heaton, weighing 60 tons.

MR. G. WOOD, of Sheffield, presided at the second annual dinner of the Yorkshire Scrap Metals and Machinery Merchants' Association, held at Leeds. The chairman remarked that there were still anxious times ahead, but it was generally agreed that we had touched bottom. So far as domestic affairs were concerned he thought the Association might congratulate itself on having done so well. Every endeavour had been made through the Federation to further the interests of members on such questions as railway rates, telephone charges, and wages; and although great effort appeared to be necessary for small results, he believed as a trade they had made their weight felt.

Company News.

United Steel Companies, Limited.— Half-yearly preference dividend, 6 per cent. per annum, less tax.

United Strip and Bar Mills, Limited. — Half-yearly preference dividend, 8 per cent. per annum, less tax.

Thomas Smith's Stamping Works, Limited. — Interim dividend for half-year to January 31 last passed.

Ossorom Foundry Company, Limited. — Capital £15,000 in £1 shares. Registered office: 28-32, Totterdown Street, Tooting, S.W.

British Hydraulic Foundry Company, Limited. — Further dividend for year passed; interim dividend, 5s. per share, free of tax.

Platt Brothers & Company, Limited.— Outstanding liability 2s. 6d. per share, to be paid by capitalising £206,120 undivided profits.

Kaye & Company (Huddersfield), Limited.—Capital £10,000 in £1 shares. Iron founders. Directors: J. Firth and R. Carrick. Registered office: Crosland Moor, Huddersfield.

Mather & Platt, Limited.—Net profits, £379,481; brought forward, £105,457; final ordinary dividend, 7 per cent., making 10 per cent., free of tax, for year; income-tax equalisation account, £40,910; carry forward, £287,662.

R. C. Whipp & Company, Limited.—Capital £9,000 in £1 shares (8,500 10 per cent. cumulative preference), to carry on the business of engineers, etc., and to adopt an agreement with R. C. Whipp. Registered office: Beehive Foundry, Tividale, Tipton.

Bruce Peebles & Company, Limited.—Preference dividends, 7½ per cent. per annum for half-year ended December 31, and further dividend 2½ per cent. per annum, both less tax, for year; ordinary dividend for year, 10 per cent. per annum, with bonus 5 per cent., both less tax.

Wallsend Slipway & Engineering Company, Limited —Profits, £174,325; brought forward, £80,489; final ordinary dividend, 6½ per cent., making 10 per cent. for twelve months; reserve, £25,000; equalisation of dividends fund, £50,000; income-tax reserve, £35,000; carry forward, £78,378.

Charles Clifford & Son, Limited.—Net profit, £8,041; brought forward, £20,230; interim dividends on preference and ordinary, £3,376; disposable, £24,894; final preference dividend, 6 per cent. per annum, less tax, £900; final ordinary dividend, 10 per cent. per annum, together with bonus, 5 per cent., both free of tax, £4,953; carry forward, £19,041.

Sheepbridge Stokes Centrifugal Castings Company, Limited.—Capital £50,000 in £1 shares (7,500 "A" and 42,500 ordinary). Engineers, manufacturers of machinery, etc., and to adopt an agreement with Stokes Castings, Limited. Directors: W. B. M. Jackson (chairman), J. T. Goodwin and F. W. Stokes (nominee of Stokes Castings, Limited). Secretary: T. E. Haslay. Registered office: Works of the Sheepbridge Coal and Iron Company, Limited, Chesterfield.

Catalogues Received.

"GUARDING THE MINUTE." The International Time Recording Company, Limited, 57, City Road, Finsbury, London, E.C.1.

"Staveley" Monthly Stock List of Cast-iron Pipes. February, 1922. The Staveley Coal and Iron Company, Limited, Chesterfield.

"POLYPHASE SELF-STARTING SYNCHRONOUS MOTORS, CROMPTON PATENT." Messrs. Crompton & Company, Limited, Chelmsford.

"THE KESTNER PATENT WATER TUBE BOILER." Messrs. Ransomes, Sims & Jefferies, Limited, Engineers, Orwell Works, Ipswich.

"CLYDELCO" SOCKETS, made to British Engineering standards specification. Messrs. Clyde Electrical Company, Palm Street, Glasgow.

"CARBOLASTIC METAL PAINT." Messrs. Roberts, Glazebrook & Company, Limited, Paint and Varnish Manufacturers, Cobden Works, Gower Street, Birmingham.

THE EASTERN EXPORT COMPANY, LIMITED, Iron and Steel Merchants, 5, Lloyd's Avenue, London, E.C.3, intimate that they are receiving so many applications for the "Universal Standard Time Indicator" that they have arranged to mail specimens to any address at 2s. each, the proceeds being devoted to the Royal Metal Trades Pension Society.

CHARLES CHURCHILL & COMPANY, LIMITED, Leonard Street, Finsbury, London, E.C.2, have been appointed sole British selling agents for the automatic screw machines, etc., of Joseph Petermann, Moutier, Switzerland.

Gazette.

MR. C. T. APPLEBY, 26, Corporation Street, Birmingham, has been appointed liquidator of the Nechells Metal Company, Limited.

TRADING in the style of F. J. Common & Company, Messrs. C. R. Common, E. Common and T. Walton, Sunderland, iron merchants and commission agents, have dissolved partnership. Debts by Mr. C. R. Common, who continues the business.

TRADING in the style of Russell, Newbery & Company, Messrs. F. C. Russell and W. Newbery, Grosvenor Road, Altrincham, gas and oil engine manufacturers and general engineers, have dissolved partnership. Debts by Mr. F. C. Russell, who continues the business.

THE partnership heretofore subsisting between Messrs. G. D. Jeavons, H. M. Maplethorpe, W. E. Nicholls and J. Taylor, engineers, Victoria Street, West Bromwich, under the style of the Staffordshire Engineering & Manufacturing Company, has been dissolved.

A MEETING of the creditors of F. A. C. Maurice, carrying on business at 61, Blythe Street, Ladywood, Birmingham, under the style of F. A. Maurice & Company, brassfounders, was held on Friday last. The debtor's statement of affairs showed gross liabilities amounting to £2,418, of which a sum of £1,097 was expected to rank for dividend. The deficiency was set at £1,097. The causes of failure, alleged by the debtor, were "incurring liability to retiring partner when taking over the business, which was insolvent, and interest on money borrowed and law costs." Mr. C. T. Appleby was appointed trustee, with a committee of inspection.

GEO. SHARPE, iron merchant, trading at Midland Chambers, Westgate Road, Newcastle, was further examined at Newcastle Bankruptcy Court on February 9. The debtor's liabilities amounted to £25,224, but he estimated that his assets were sufficient to cover them He declared that he was not insolvent, and attributed his failure to inability to collect money due to him. At a previous hearing debtor had denied that he had made a gift to a Government official to influence the giving of contracts. The unsecured liabilities included £21,516 for goods purchased from the Admiralty, the petitioning creditors. Answering Mr. Park, who appeared for the Admiralty, debtor again denied that he had paid commissions to men named Russell and Bucklan, both of whom, he understood, were in bankruptcy. The Official Receiver informed the Registrar that the stories told by the two persons, Russell and Bucklan, who were bankrupts in London, did not tally with the account given by Sharpe. He therefore asked for an adjournment to investigate the discrepancies. The hearing was adjourned.

THE NAMES of the undermentioned companies have been struck off the Register of Joint Stock Companies, and such companies are dissolved:—Aero Engine Reconstruction Company, Limited; Anglo-Colonial Engineering Company, Limited; Crisp Engineering Company, Limited; Electromotor Equipment Company, Limited; General Engineering Accessories, Limited; Hughes' Patent Nut-Fastener, Limited; North-East Coast Engineering Works (Hull), Limited; Radcliffe Engineering Works, Limited; Tasmanian Smelting Company, Limited; and the Unity Wood & Iron Company, Limited.

Deaths.

MR. JOHN DAVIES, J.P., manager of the Cardigan Engineering Works, has died at the age of 75.

MR. J. BISSET, chairman of R. B. Tennant, Limited, Whifflet Foundry, Coatbridge, died on the 10th inst., at his residence, the Willows, Carmyle.

THE DEATH of Mr. Gavin Alexander Cuthbertson, which took place on February 12, at his residence, 10, Manor Terrace, Headingley, will be sincerely regretted by many friends. Mr. Cuthbertson was for more than 30 years Yorkshire District Manager for the Pulsometer Engineering Company, of Reading.

MR. ALFRED PEARCE, of Augustus Pearce & Sons, iron, steel and coke merchants,, 129, Carlisle Street East, Sheffield, died at his residence, 31, Barkers Road, Sheffield, on the 9th ult. Owing to very indifferent health, he had been prevented from taking any active part in the management of the business for a considerable period, and the firm will continue to be carried on, under the same style as before, by Mr. Charles Henry Pearce, who for many years has been the managing partner.

THE LATE MR. A. W. HERVE, screw manufacturer, of Bentley Road, Kingsland, and Clerkenwell Road, left £120,043, the net personalty being £117,138.

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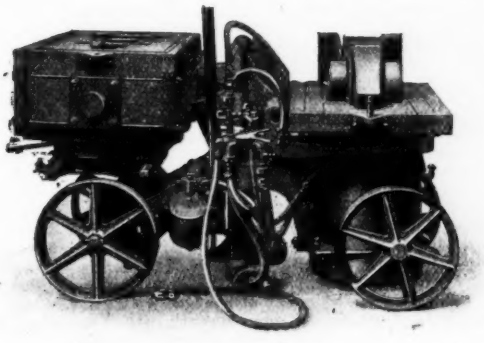

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IRON AND STEEL MARKETS.

Pig-iron.

Conditions in most of the principal centres of the pig-iron industry have unquestionably broadened out to some extent of late, and with an entire disappearance of Continental competition, and more activity in the foundry trade, the outlook must be pronounced as more promising for future expansion. In South Staffordshire, however, the firmer tendency recently noted in pig-iron values is attributed entirely to a stiffening of fuel prices, which, combined with the still too heavy cost of transport, leaves little ground for optimistic views of early recovery. In the West of Scotland business continues on the quiet side, makers of light castings in the Falkirk district being on short time, but a little improvement may be noted in the export demand, foreign shipments of pig-iron having totalled 555 tons last week, of which 500 tons went to Italy, as compared with 86 tons for the corresponding period last year. On Tees-side there has been a slight reaction after the activity of the past fortnight, inquiries having been in reduced volume, due perhaps to the impending labour troubles in the engineering trade. Smelters are, however, well sold over the next few weeks, and as the Cargo Fleet Iron and Steel Company, Limited, has just put another furnace into operation it is evident that iron makers take a fairly sanguine view of the future of the industry. This increases the number of furnaces in blast on the North-East Coast to 28. Although, probably, the subject of recent discussion by ironmasters, no advance in the prices of Cleveland iron has been attempted, market opinion being decisive to the effect that any movement in this direction would certainly retard the revival of demand now so urgently required in the pig-iron trade. Cleveland foundry iron prices are consequently unchanged, No. 1 being quoted 95s. per ton, No. 3 Cleveland G.M.B. 90s., No. 4 foundry 87s. 6d., No. 4 forge 82s. 6d., and mottled and white 75s. per ton f.o.t. or f.o.b.

There is still some inquiry from Italy for East Coast hematite, though less than there has been. Some iron has also been sold to Czecho-Slovakia via Germany, and although the home demand is not so brisk, makers have good order books and are not pressing sales, mixed numbers now being firmly quoted at 97s. 6d. and No. 1 at 98s. 6d. per ton. West Coast Bessemer mixed numbers are unchanged at £4 18s. 6d. per ton at works.

Finished Iron.

Few signs are as yet observable of improvement in the finished iron section of the trade, and judging by the number of forges and mills still unemployed any prospect of an early revival of demand is almost out of the question. Makers of marked bars manage to maintain outputs to a limited extent on specifications previously booked, but are, so far, unable to point to any improvement in demand traceable to the recent price reduction. Manufacturers of crown and commoner qualities of bar iron are now subject to severe competition, both home and Continental, and some price-cutting is said to be practised. South Staffordshire makers of crown bars deny any suggestion of accepting less than £12 as stipulated by the Association, while buyers maintain that offers of 10s. below that figure will secure deliveries. Lancashire bars are, however, firm at £12 delivered. Producers of nut and bolt iron are experiencing a lean time, for which home quotations rule at round about £10 15s. per ton, while Continental bars have recently been offered at a price working out at £9 11s. delivered. It is obviously impossible for home manufacturers to compete with prices at these levels, and most of the works turning out this class of material are idle.

Scrap.

Reports from the various markets for scrap metal generally indicate little change in the position of the trade, business as a rule being extremely quiet, with here and there some occasional activity of demand for the better quality materials. At Middlesbrough heavy steel scrap is only in quiet demand at about 60s. per ton, with heavy steel turnings at about 42s. 6d. per ton. Cast-iron borings are quoted at 40s. to 42s. per ton, with machinery quality making £4 5s. per ton, and bushelling scrap about 62s. 6d. per ton, all delivered works.

Steel.

So far, recovery in the various branches of the steel trade proceeds at a slow pace, although it is admitted that inquiries on overseas account are coming to hand in slightly better volume, but buying, as a rule, is confined to the barest possible requirements. At Sheffield, while some departments are doing fairly well, others are entirely idle or only partially employed. The heavy branches are still awaiting the placing of orders for railway material, which cannot now be long delayed, as it is general knowledge that the majority of the companies have allowed their repairs and renewals to fall largely into arrears, while stocks remaining are almost exhausted. In semi-products there has been a little more active buying, but this has been mostly on a hand-to-mouth scale, leaving prices unchanged on the week. There has also been some slight improvement in the steel export trade, but the production of steel ingots and castings in January showed a further decline to 327,500 tons, compared with 381,000 tons in December and 443,800 tons in November. On the North-East Coast the steel trade is extremely quiet, and there are still no indications of any revival.

Tinplates.

Business in the tinplate market shows little improvement on last week's report, buying having been limited to unimportant proportions, with inquiries much lighter in volume than the recent average. Quotations for I C 14 x 20, 112 sheets, 108 lbs., in coke finish rule about 18s. 9d. to 19s. per box for spot delivery, but for March-April 18s. 6d. would be accepted, and possibly a little less for a decent order. There has been only a moderate demand for coke wasters, current quotations being about as follows:—C W 14 x 20, 112 sheets, 108 lbs., 17s. 3d. to 17s. 6d. per box; C W 28 x 20, 112 sheets, 216 lbs., 35s. to 35s. 3d. per box; C W 14 x 18¾, 124 sheets, 110 lbs., 18s. 6d. per box; C W 20 x 10, 225 sheets, 156 lbs., 22s. per box.

Metals.

Copper.—After last week's depressing experience in the standard copper market it was a little more encouraging to note a better tone at Monday's opening, some heavy speculative purchases on forward account influencing a sharp rally in values. Demand from consumers, however, continues unsatisfactory at home and abroad, and until some recovery is effected in this direction, buying is almost certain to be confined to the speculative element in the market. At the close March dates were quoted £58 7s. 6d. to £59 15s.; April, £60; May, £59 12s. 6d. Refined qualities of copper were firm and unchanged. Closing prices:—Cash: Wednesday, £57 7s. 6d.; Thursday, £57 7s. 6d.; Friday, £58; Monday, £59 15s.; Tuesday, £58 15s. Three months: Wednesday, £58 7s. 6d.; Thursday, £58 7s. 6d.; Friday, £58 17s. 6d.; Monday, £60 15s.; Tuesday, £59 15s.

Tin.—In common with other metals tin has undergone a further relapse, due to heavy realisations and lack of confidence in the stability of market conditions, having shown at one time last week a drop of over £8 per ton. Better Eastern advices at this week's opening market, however, imparted a stronger tendency to values, giving also an impetus to sales forward, March dates realising £146 10s. to £146 5s.; April, £146 10s. to £147 5s., up to £149 5s., with both positions showing an improvement on balance. English ingots were also favourably influenced, closing 75s better at £146 15s. London tin stocks are 109 tons heavier on the week at 4,980 tons, Liverpool being 5 tons lighter at 1,803 tons, with Swansea stocks unchanged at 10 tons. Closing prices:—Cash: Wednesday, £140 2s. 6d.; Thursday, £142; Friday, £144; Monday, £147 10s.; Tuesday, £145. Three months: Wednesday, £142 2s. 6d.; Thursday, £144; Friday, £146 5s.; Monday, £149 10s.; Tuesday, £146 15s.

Spelter.—Business in the market for spelter continues quiet, but in the absence of selling pressure, values have remained steadier than has been experienced in the case of other metals. Closing prices:—Ordinary brands: Wednesday, £24 7s. 6d.; Thursday, £24 15s.; Friday, £24 15s.; Monday, £24 17s. 6d.; Tuesday, £24 12s. 6d.

Lead.—Conditions in the market for soft foreign pig have been practically identical with those experienced in other metals, a relapse in values last week having been followed by a partial recovery which, so far, has been maintained. English closing prices: Wednesday, £21; Thursday, £21 10s.; Friday, £21 15s; Monday, £21 15s.; Tuesday, £21 15s.

Works of J. G. Kincaid & Company, Limited.—In our issue of February 23, we stated that John G. Kincaid & Company, Limited, engineers, of Greenock, were to close down their works at an early date. We are informed that this applies to the branch works at Arthur Street only, which are being temporarily closed, the work in the meantime being transferred to the main establishment at East Hamilton Street.